

AD-A036 245

CALIFORNIA UNIV SANTA BARBARA GEOGRAPHY REMOTE SENSI--ETC F/G 17/9
SUMMARY EVALUATION OF THE OFFSHORE TARGET DETECTION CAPABILITY--ETC(U)
DEC 76 J E ESTES, S P KRAUS

UNCLASSIFIED

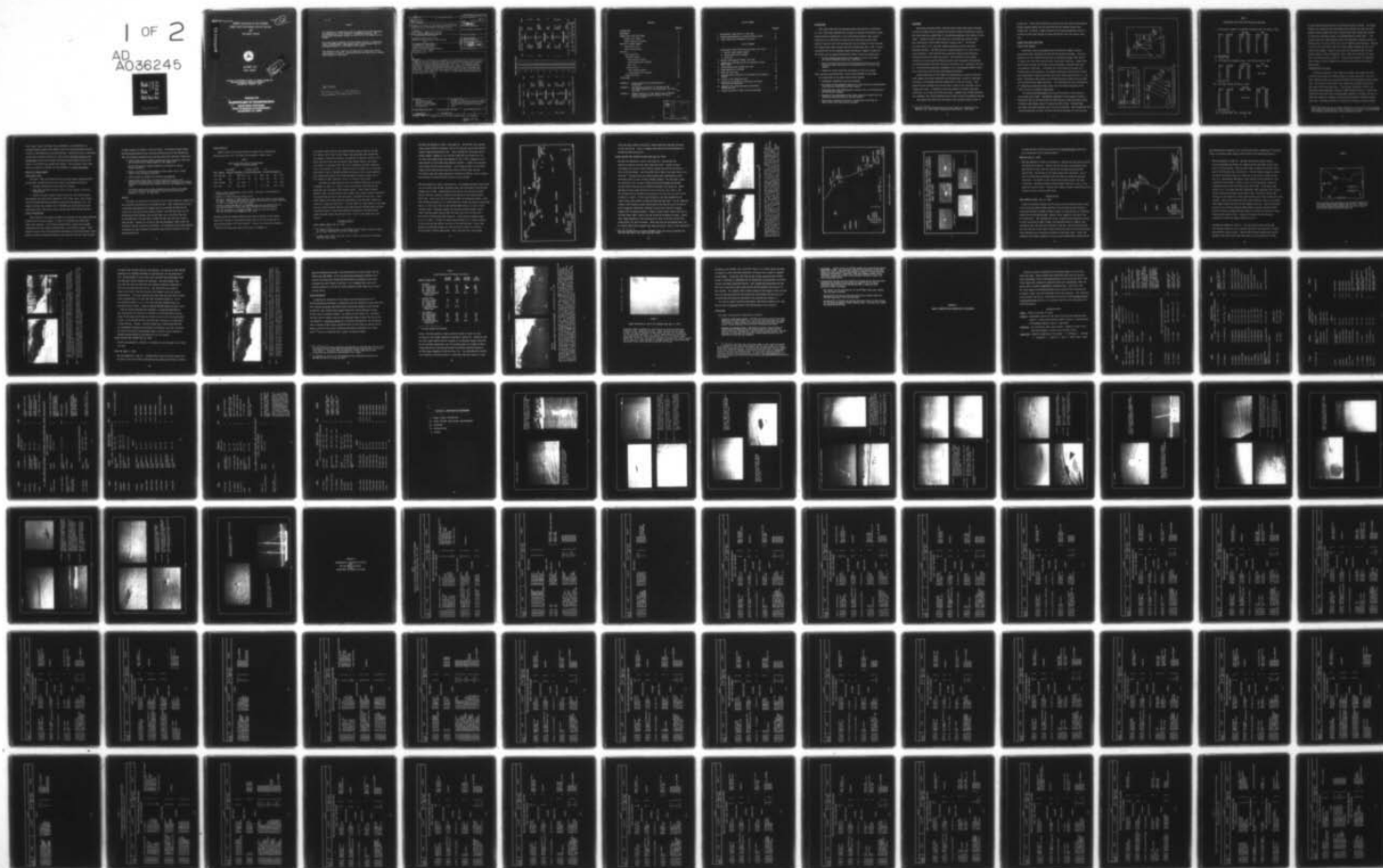
USCG-D-125-76

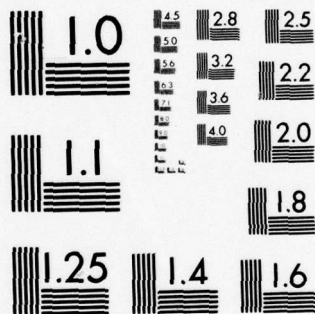
DOT-CG-63898-A

NL

1 OF 2

AD
A036245





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

REPORT NO. CG-D-125-76

SUMMARY EVALUATION OF THE OFFSHORE
TARGET DETECTION CAPABILITIES OF APS-94D
AND
COR RADAR SYSTEMS

ADA 036245



DECEMBER 1976
FINAL REPORT



Document is available to the U. S. public through the
National Technical Information Service,
Springfield, Virginia 22161

PREPARED FOR
U.S. DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD
OFFICE OF RESEARCH AND DEVELOPMENT
WASHINGTON, D.C. 20590

NOTICE

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof.

The United States Government does not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the object of this report.

The contents of this report do not necessarily reflect the official view or policy of the U.S. Coast Guard and do not constitute a standard, specification, or regulation.

440062

California Univ., Santa Barbara.
Geography Remote Sensing Unit

1. Report No. USCG-D-125-76 ✓	2. Government Accession No.	3. Recipient's Catalog No. 11 12 105 p.1
4. Title and Subtitle Summary Evaluation of the Offshore Target Detection Capabilities of APS-94D and COR Radar Systems	5. Report Date December 1976	6. Performing Organization Code
7. Author(s) John E. Estes and Steven P. Kraus	8. Performing Organization Report No.	9. Performing Organization Name and Address Geography Remote Sensing Unit University of California, Santa Barbara
10. Work Unit No. (TRAIS)	11. Contract or Grant No. DOT-CG-63-898-A	12. Sponsoring Agency Name and Address Department of Transportation United States Coast Guard Office of Research and Development Washington, D.C. 20590
13. Type of Report and Period Covered Final Report May 1976 - July 1976	14. Sponsoring Agency Code	15. Supplementary Notes
16. Abstract Flight tests of an APS-94D real aperture and coherent-on-receive (COR) synthetic aperture radar were conducted by the Coast Guard in three locations of southern and central coastal California between May 19-21 1976. The Geography Remote Sensing Unit provided comprehensive ground truth support coincident with radar overflights. Imagery from the APS-94D and COR radar sets was interpreted and evaluations of the target detection capabilities and resolution characteristics of the two systems conducted. The analysis included both man-made targets and natural seep oil slicks.		
17. Key Words real aperture radar Coherent-on-Receive synthetic aperture radar oil detection	18. Distribution Statement Document is available to the U.S. public through the National Technical Information Service, Springfield, Virginia 22151	
19. Security Classif. (of this report) UNCLASSIFIED	20. Security Classif. (of this page) UNCLASSIFIED	21. No. of Pages 22. Price

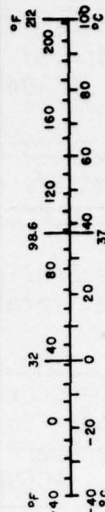
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
LENGTH				
in	inches	2.5	centimeters	cm
ft	feet	30	meters	m
yd	yards	0.9	kilometers	km
mi	miles	1.6		
AREA				
in ²	square inches	6.5	square centimeters	cm ²
ft ²	square feet	0.09	square meters	m ²
yd ²	square yards	0.8	square meters	m ²
mi ²	square miles	2.6	square kilometers	km ²
	acres	0.4	hectares	ha
MASS (weight)				
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
VOLUME				
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft ³	cubic feet	0.03	cubic meters	m ³
yd ³	cubic yards	0.76	cubic meters	m ³
TEMPERATURE (exact)				
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price \$2.25, SD Catalog No. C13.10-286.

Symbol	When You Know	Multiply by	To Find	Symbol
LENGTH				
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
AREA				
cm ²	square centimeters	0.16	square inches	in ²
m ²	square meters	1.2	square yards	yd ²
km ²	square kilometers	0.4	square miles	mi ²
ha	hectares (10,000 m ²)	2.5	acres	
MASS (weight)				
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
VOLUME				
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m ³	cubic meters	35	cubic feet	ft ³
m ³	cubic meters	1.3	cubic yards	yd ³
TEMPERATURE (exact)				
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



CONTENTS

	Page No.
INTRODUCTION	1
BACKGROUND	2
GROUND TRUTH DATA COLLECTION	3
Ground Truth Support	3
Identification of Targets	6
ANALYSIS OF RADAR IMAGERY	7
Image Acquisition	7
Image Interpretation	7
RESULTS	8
Target Detection	9
Man-Made Targets	10
Santa Barbara Channel	10
Oxnard-Ventura-Port Hueneme	13
Morro Bay	17
Surface Slicks	17
Santa Barbara Channel	17
Oxnard-Ventura-Port Hueneme	22
Target Resolution	24
CONCLUSIONS	28
APPENDIX A - Target Information and Representative Photographs	A-1
APPENDIX B - Comprehensive Evaluation of APS-94D and COR for Target Detection in the Southcentral California Test Area	B-1
APPENDIX C - Summary Evaluation of the Capabilities of APS-94D and COR to Detect Selected Targets Off South- central California	C-1

[illegible]

LIST OF TABLES

	<u>Page No.</u>
1. Approximate Flight Paths for Radar Runs	5
2. Detection/Non-Detection of Known Offshore Targets	9
3. Target Resolution Performance Evaluation	25

LIST OF FIGURES

1. Approximate Flight Tracks During the May 19-21 Tests	4
A. Western Santa Barbara Channel	4
B. Oxnard-Ventura-Port Hueneme	4
C. Morro Bay	4
2. Western Santa Barbara Channel Test Area	12
3. Comparison of APS-94D and COR for Detection of Man-Made Targets	14
4. Oxnard-Ventura-Port Hueneme Test Area	15
5. Range Detection of APS-94D	16
6. Morro Bay Test Area	18
7. Wind and Swell Directions in the Western Santa Barbara Channel	20
8. Surface Slicks Detected by COR	21
9. Comparison of APS-94D Oil Detection Performance from Two Look Directions	23
10. Comparison of Target Resolution Performance : APS-94D and COR	26
11. Target Resolution of COR in the Overland Mode	27

INTRODUCTION

This report describes the Geography Remote Sensing Unit's involvement in a U.S. Coast Guard sponsored test program to evaluate the offshore surface target detection capabilities of two side-looking airborne radar systems. Flight tests of an APS-94D real aperture and coherent-on-receive (COR) synthetic aperture radar were conducted by the Coast Guard in three locations off southern and central coastal California between May 19-21, 1976. Primary responsibilities of the Geography Remote Sensing Unit (GRSU) in support of the flight test and image interpretation phases of the test program were:

- * Provide comprehensive ground truth support in each of the three test areas coincident with radar overflights.
- * Assess the target detection and resolution characteristics of the APS-94D and COR radars based on interpretation of the flight test imagery.
- * Compare the target detection performances of the two systems.

These tasks were performed under contract DOT-CG-63898A (14 May 1976).

The subsections of the report which follow provide:

- * Background information on the test program;
- * An account of the procedures employed in acquiring and recording ground truth data and identifying surface targets;
- * A description of the methodological approach used in interpreting the APS-94D and COR imagery;
- * Results of our evaluations of the target detection capabilities and resolution characteristics of the two systems;
- * Conclusions regarding the relative capabilities of APS-94D and COR to detect and image offshore targets.

BACKGROUND

During the period May 19-21, 1976 the United States Coast Guard sponsored a series of flight tests off southern and central coastal California to evaluate the target detection capabilities of two Motorola-developed side-looking airborne radars. Systems involved in the tests were an APS-94D real aperture radar and a coherent-on-receive (COR) synthetic aperture radar.* The APS-94D was flown aboard a U.S. Army OV-1 Mohawk observation aircraft from Fort Huachacha, Arizona. The COR system was installed aboard a U.S. Army C-47 on loan to Motorola. Both aircraft were temporarily based at NAS Point Mugu, California during the flight test period. Participating in the program, in addition to Coast Guard and Army personnel, were researchers and engineers from the Government Electronics Division of Motorola, Inc., Scottsdale, Arizona; U.S. Naval Research Laboratory, Washington, D.C.; and Geography Remote Sensing Unit, University of California, Santa Barbara California.

Primary objectives of the flight test program were to acquire sufficient radar imagery and ground truth/field verification data to permit a meaningful evaluation of the target detection capabilities of the two systems. These objectives were achieved the first day when a total of ten coincident runs of imagery were flown. Originally it had been planned to schedule coincident overflights in at least two of the test areas. However, once flight operations were underway, this proved infeasible due to minor aircraft maintenance problems.

Both radars were flown over the western Santa Barbara Channel on May 19

* Detailed technical descriptions of the two radars are contained in the Motorola, Inc. draft report submitted to Coast Guard, 1 July 1976.

(Figure 1A). On May 20, the APS-94D was airborne over the eastern Santa Barbara Channel imaging targets off the Oxnard-Ventura-Port Hueneme coastal area (Figure 1B). On May 21, flight operations were moved approximately 150 miles northwest to Morro Bay (Figure 1C) where the COR aircraft flew several radar runs.

GROUND TRUTH DATA COLLECTION

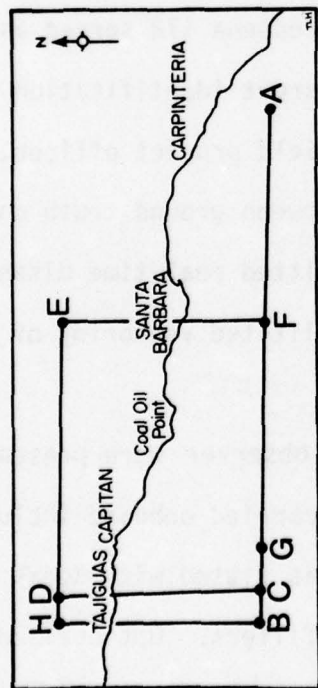
Ground Truth Support

Researchers from the Geography Remote Sensing Unit (GRSU) collected ground truth data coincident with the APS-94D and COR overflights. The major objectives of this support activity were to identify potential radar targets in each of the test areas and accurately record their locations. Ground truth data formats included low altitude aerial photographs, detailed sketch maps, and extensive field notes. A chartered four-seat Cessna 172 served as an airborne observation platform. All ground truth/target identification flights were coordinated in advance with the Coast Guard field project officer, LT Les Wiley. Continuous radio contact was maintained between ground truth and radar test aircraft during flight operations. This permitted real time dissemination of information concerning surface targets and facilitated vectoring of the light aircraft to targets of opportunity.

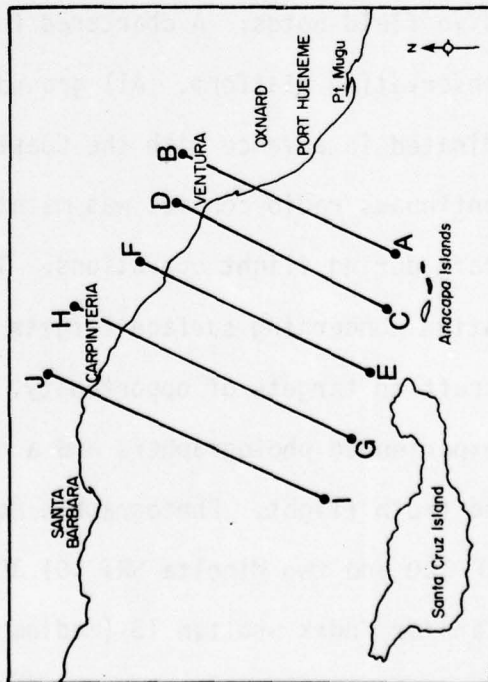
Two experienced photographers and a qualified observer were present on each ground truth flight. Photographic equipment carried onboard included a Minolta SRT 100 and two Minolta SRT 101 35mm cameras fitted with Kodak wratten 1A (haze) and/or Kodak wratten 15 (medium yellow) filters. Optional 28mm wide angle and 135mm telephoto lenses also were available. Color (Kodachrome 25), infrared Ektachrome (IE-135), and black and white (Panatomic X) film was used

FIGURE 1

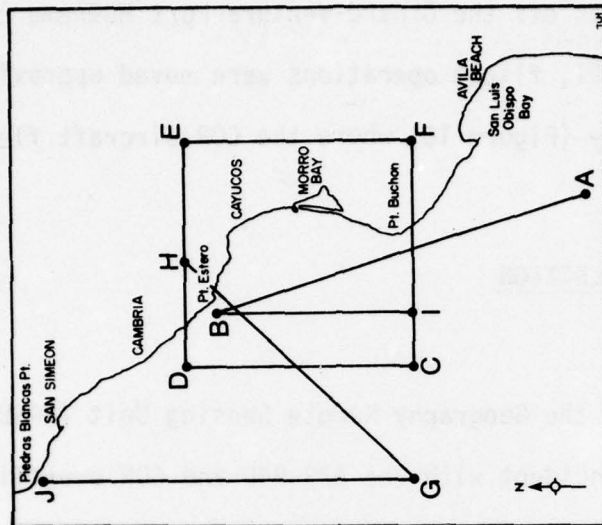
APPROXIMATE FLIGHT TRACKS FLOWN BY SENSOR AIRCRAFT DURING THE MAY 19-21, 1976 RADAR TESTS



A. Western Santa Barbara Channel (May 19, 1976).



B. Oxnard-Ventura-Port Hueneme offshore (May 20, 1976).



C. Morro Bay (May 21, 1976).

TABLE 1

APPROXIMATE FLIGHT PATHS FOR INDIVIDUAL RADAR RUNS

I. Santa Barbara Channel; 10 coincident APS-94D and COR runs (May 19, 1976)

Run #	From/To *	APS-94D		COR	
		Delay	Mode	Delay	Mode
0	A-B	0 km	O.L.	0 km	O.W.
1	C-D	0	O.L.	0	O.W.
2	D-E	0	O.L.	0	O.W.
3	E-F	0	O.L.	0	O.L.
4	F-G	0	O.L.	0	O.L.
5	C-D	0	O.L.	0	O.W.
6	D-E	0	O.L.	0	O.W.
7	E-F	0	O.L.	0	O.L.
8	F-C	0**	O.L.	0	O.L.
9	B-H	0	O.L.	20	O.L.

* See Figure 1A

** 0-50 km range

II. Off Oxnard-Port Hueneme-Ventura; 7 APS-94D runs (May 19, 1976)

Run #	From/To *	APS-94D		COR	
		Delay	Mode	Delay	Mode
0	B-A	0 km	O.L.		
1	A-B	10	O.L.		
2	C-D	20	O.L.		
3	E-F	20	O.L.		
3A	E-F	30	O.L.		
4	G-H	40	O.L.		
5	I-J	50	O.L.		
				Not Flown	

* See Figure 1B

III. Morro Bay; 10 COR runs (May 12, 1976)

Run #	From/To *	APS-94D		COR	
		Delay	Mode	Delay	Mode
8	A-B			0 km	O.W.
9	C-D			0	O.W.
10	D-E			0	O.W.
11	E-F			0	O.L.
12	F-C			0	O.L.
13	G-H			20	O.W.
14	E-F			0	O.W.
15	F-I			0	O.W.
16	I-B			0	O.W.
17	J-G			0	O.W.
		Not Flown			

* See Figure 1C

O.L., overland mode; O.W., overwater mode

to insure maximum identification of man-made and natural targets. The flight observer was responsible for maintaining radio communication with the field project officer, taking field notes, drawing sketch maps showing the location of moving and stationary targets, and keeping detailed camera logs.* For safety reasons the single-engined Cessna 172 maintained a minimum altitude of 400 feet when over the surfline and at least 1,000 feet when offshore. Marginal visibility over the three flight test areas somewhat reduced the quality of ground truth imagery. Medium to heavy haze was encountered over the Santa Barbara Channel on May 19 and May 20, and a 1,500 foot cloud base off Morro Bay restricted operations on May 21. Despite these problems, all potential radar targets visually sighted by the ground truth team were successfully photographed.

Identification of Targets

Following completion of the flight test program, the rough draft field notes and sketch maps were finalized and all film was processed. Color and color infrared slides were sorted and annotated with information from the camera logs. The location of individual radar targets was recorded on preliminary base maps of each overflight area. Fixed targets (excluding vessels) were identified from photographic evidence or NOAA navigation charts. Vessels were identified using field notes and photographic evidence or through inquiries to commercial operators, fishermen, and Coast Guard personnel familiar with the test areas. Detailed statistical information on stationary man-made targets

* Camera logs contained the following information for each roll of film exposed: roll number and frame number, subject (target) and location, aircraft heading and altitude, approximate time, and miscellaneous remarks

(e.g. buoys, floats, moorings, piers, breakwaters, and platforms) was obtained through contacts with federal, state and local government officials as well as representatives of private industry. Statistical data on individual vessels were extracted from the U.S. Coast Guard's Merchant Vessels of the United States (publication CG-408, 1974 ed), provided through contacts with owners, or estimated from ground truth imagery. Once obtained, these target data were compiled in tabular form (see Appendix A, Target Information).

ANALYSIS OF RADAR IMAGERY

Image Acquisition

On June 4, 1976, representatives from the Coast Guard, Geography Remote Sensing Unit, and Motorola met at the latter's Scottsdale facility to:

- * Exchange information on the flight test program;
- * View color and color infrared slides of radar targets in the over-flight areas;
- * Examine the radar imagery acquired during the test flight program.

Approximately two weeks after completion of the flight tests, radar imagery from the APS-94D and COR overflights was obtained from Motorola, Inc. The imagery included copy negatives for 17 APS-94D runs and 28 COR runs flown between May 19-21, and contact prints from the May 19 APS-94D and COR runs.

Image Interpretation

Upon receipt of the imagery we began our evaluation of the target detection capabilities of the two systems. A total of 17 APS-94D and 20 COR radar images were analyzed. To facilitate interpretation, images were arranged sequentially by radar system, overflight date, and flight run number. Radar images for each run were interpreted by individuals who had participated in the ground truth data collection program and were familiar with the known location

of major targets of interest in the test areas. To determine target detectability/non-detectability and resolution characteristics of the APS-94D and COR, the following procedures were used when evaluating individual flight runs:

- * Ground truth data and target location maps were reviewed to determine the locations of all known targets in the imaged area.
- * Marine and nearshore targets imaged were annotated on frosted acetate overlays.
- * Where a correlation existed between a known target and an imaged target it was recorded as detected.
- * Known targets not imaged were annotated not detected.
- * Comprehensive target data, including target type, slant range distance from the aircraft, location, material composition, and whether detected or not detected were compiled for each run (Appendix B, Tables 1-4).
- * Individual target returns were evaluated for resolution and ranked on a scale from poor to good based on qualitative criteria (see Appendix C, Parts I, II, and III).

RESULTS

Following are results of our evaluation of the target detection capabilities and resolution characteristics of APS-94D and COR. These determinations based on detailed interpretation of imagery from ten coincident APS-94D and COR flights over the western Santa Barbara Channel, seven APS-94D radar runs off Oxnard-Ventura-Port Hueneme, and ten COR radar runs in the Morro Bay area. All APS-94D radar runs were flown at 6500 feet ASL; COR runs were flown at 5500 feet ASL. Figures 1A, 1B and 1C show the approximate flight tracks for the May 19, May 20, and May 21 overflights. An accompanying data sheet provides information on range and mode of operation (overland and overwater) for each APS-94D and COR run.

Target Detection

Summary results of the target detection capabilities of APS-94D and COR during the May 19-21, 1976 tests are presented in Table 2 below.

TABLE 2

Detection/Non-Detection of Known Offshore
Targets by APS-94D and COR*

Date	System	Man-Made ^A	Surface Slicks ^B				All			
		Possible ^C	Detected	%	Possible	Detected	%	Possible	Detected	%
5/19	APS-94D	163	156 ^D	95.7	38	11	28.9	201	167	83.1
5/19	COR	162	121 ^E	74.7	38	25	65.8	200	146	73.0
5/20	APS-94D	96 ^E	93	96.9	0	0	..	96	93	96.9
5/21	COR	178	169	94.9	2	0	0.0	180	169	93.9

^A Buoys, floats, and moorings; piers, pilings, rock groins, and breakwaters; platforms and vessels.

^B Natural oil seeps and oily alcohol spills.

^C Derived by counting all known targets in each image overflight area and adding the total. APS-94D and COR totals for 5/19 do not agree due to slight variations in radar run flight tracks and areas imaged.

^D Anchored crewboat MALLARD and tug CONTENDER counted as one detected and one not detected target in those cases where APS-94D or COR merged returns.

^E Does not include the oil workboat CALDWELL which was tied up alongside drilling ship CUSS I and imaged with the latter.

APS-94D achieved the highest detection rate against man-made surface targets, imaging 95.7 percent of the possible targets (156 of 163) during the May 19 test and 96.9 percent (93 of 96) on May 20. COR was less consistent, detecting

* Data in this table were compiled from Table 1-4 Appendix B.

94.9 percent (169 of 178) of the known man-made targets on May 21, but only 74.7 percent (121 of 162) on May 19 when flown coincident with the APS-94D. COR, however, proved more successful than APS-94D in detecting surface slicks. During the May 19 test over the western Santa Barbara Channel, COR imaged 65.8 percent of the known slicks (25 of 38), compared to APS-94D's detection rate of 28.9 percent (11 of 38). Based on analysis of data for the coincident overflights of May 19, APS-94D exhibited the highest overall target detection rate imaging 86.6 percent of the known man-made and natural targets (167 of 201) compared to COR's detection rate of 73.0 percent (146 of 200).*

Comprehensive target detection data for offshore flight tests are found in Appendix B, Table 1-4. Tables 1 and 2 cover the May 19 APS-94D and COR operations over the western Santa Barbara Channel. Table 3 details May 20 APS-94D flights off Oxnard-Ventura-Port Hueneme, while Table 4 records information interpreted from the May 21 COR overflights of the Morro Bay test area. These tables document the target detection performance of the two radar systems on a run-by-run, target-by-target basis. For each radar run, known targets in the image area are listed by target type and slant range distance from the sensor aircraft. A detailed analysis of the target detection performance of APS-94D and COR against man-made targets and surface slicks in each of the flight test areas follows:

Man-Made Targets**

SANTA BARBARA CHANNEL (May 19, 1976)

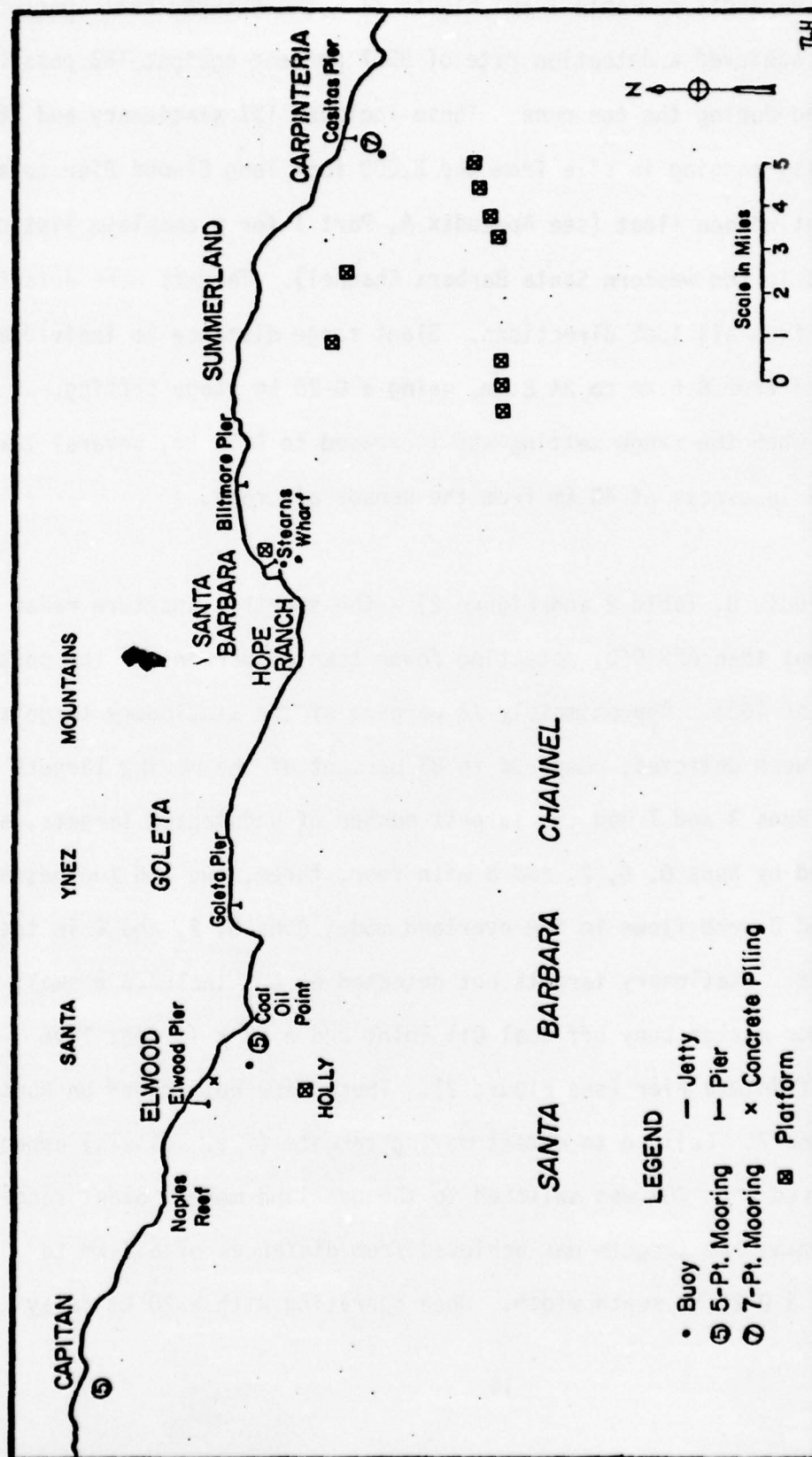
* The number of known targets on the APS-94D and COR imagery differed slightly due to minor variations in aircraft flight paths.

** Includes buoys, floats, moorings, piers, pilings, rock groins, breakwaters, platforms, and vessels.

- APS-94D (see Appendix B, Table 1 and Figure 2) - the APS-94D real aperture radar system achieved a detection rate of 95.7 percent against 163 possible targets imaged during the ten runs. These included 137 stationary and 26 moving targets, ranging in size from the 2,000 foot long Elwood Pier to a 16 square foot wooden float (see Appendix A, Part I for a complete list of known targets in the western Santa Barbara Channel). Targets were detected consistently from all look directions. Slant range distance to individual targets varied from 8.6 km to 24.8 km, using a 0-25 km range setting. During Run 9 when the range setting was increased to 0-50 km, several targets were detected in excess of 40 km from the sensor aircraft.

- COR (see Appendix B, Table 2 and Figure 2) - the synthetic aperture radar proved less consistent than APS-94D, detecting fewer than 75 percent of the possible targets (121 of 162). Approximately 73 percent of the stationary targets (101 of 138) were detected, compared to 83 percent of the moving targets (20 of 24). Runs 3 and 7 had the largest number of undetected targets, seven each, followed by Runs 0, 6, 2, and 8 with four, three, two and two respectively. Runs 3, 7, and 8 were flown in the overland mode; Runs 0, 2, and 6 in the overwater mode. Stationary targets not detected by COR included a small radar reflector marker buoy off Coal Oil Point and a 22 x 12 foot live bait float off Goleta Pier (see Figure 2). These were not imaged on Runs 0, 2, 3, 6, and 7. Failure to detect moving targets (i.e. vessels) appears to have occurred when COR was switched to the overland mode. Slant range detection of man-made targets was achieved from distances of 6.5 km to 24.6 km using a 0-25 km swath width. When operating with a 20 km delay

FIGURE 2



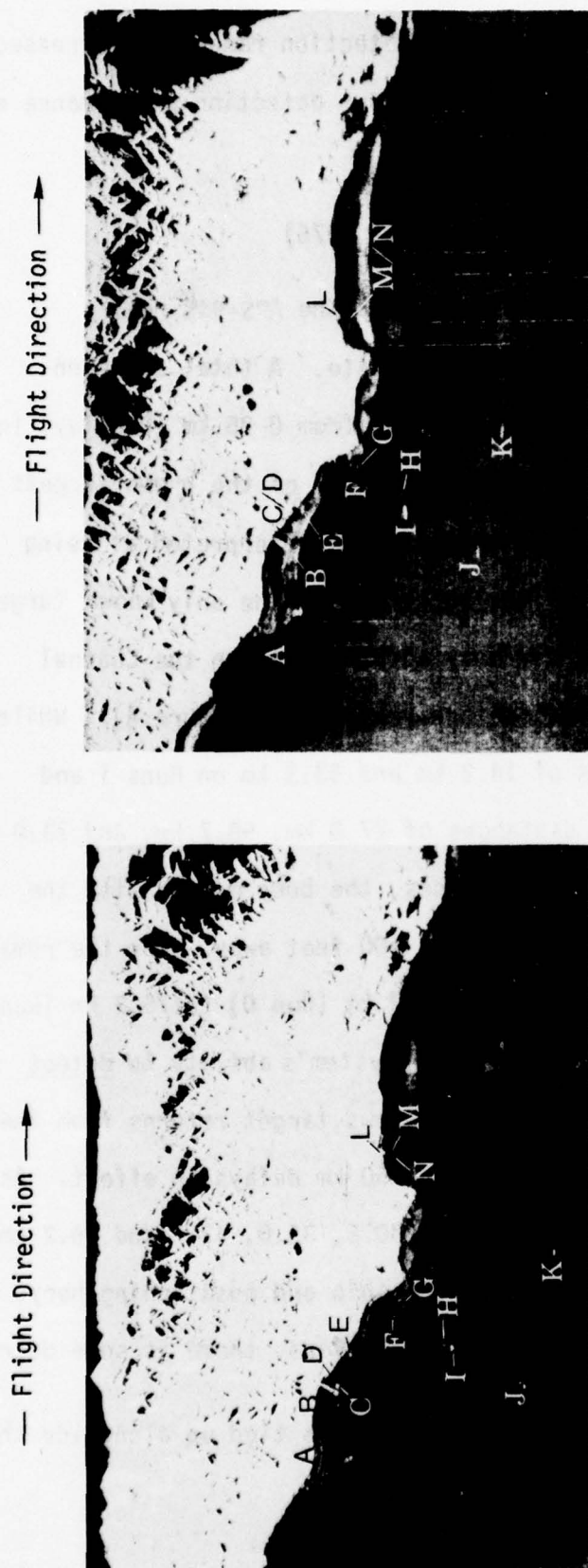
(20-45 km swath width) during Run 9, target detection range was increased to more than 40 km. Figure 3 compares the target detection performance of APS-94D and COR during Run 6.

OXNARD-VENTURA-PORT HUENEME OFFSHORE AREA (May 20, 1976)

- APS-94D (see Appendix B, Table 3 and Figure 4) - the APS-94D real aperture system was the only radar flown this date. A total of seven overflights were made at range settings varying from 0-25 km (0 delay) to 50-75 km (50 km delay). Over 95 percent (93 of 96) of the known targets were detected.* Seventy-nine of the known targets were interpreted as being stationary while 17 were classed as moving targets. The only known target not detected on all runs was a marker buoy located between the Channel Islands Harbor entrance and an offshore breakwater (see Figure 4). While detected at slant range distances of 14.2 km and 53.3 km on Runs 1 and 3A, the buoy was not detected at distances of 27.8 km, 58.7 km, and 73.0 km on Runs 2, 4, and 5. At the longer distances, the buoy merged with the return from a rock seawall located less than 100 feet away. For the remaining targets, slant range to target varied from 5.8 km (Run 0) to 75.3 km (Run 5) with no apparent significant reduction in the system's ability to detect targets with increasing distance. Figure 5 shows target returns from the oil drilling vessel CUSS I with 0, 20, 30, 40 and 50 km delays in effect. Actual slant range distances to the vessel are 8.0, 30.6, 35.0, 42.7 and 56.2 km, respectively, for the five delays. While the ship and positioning buoys can be readily identified throughout the range variations, there is some degradation

* Does not include the oil workboat CALDWELL which was tied up alongside the drilling ship CUSS I and imaged with the latter.

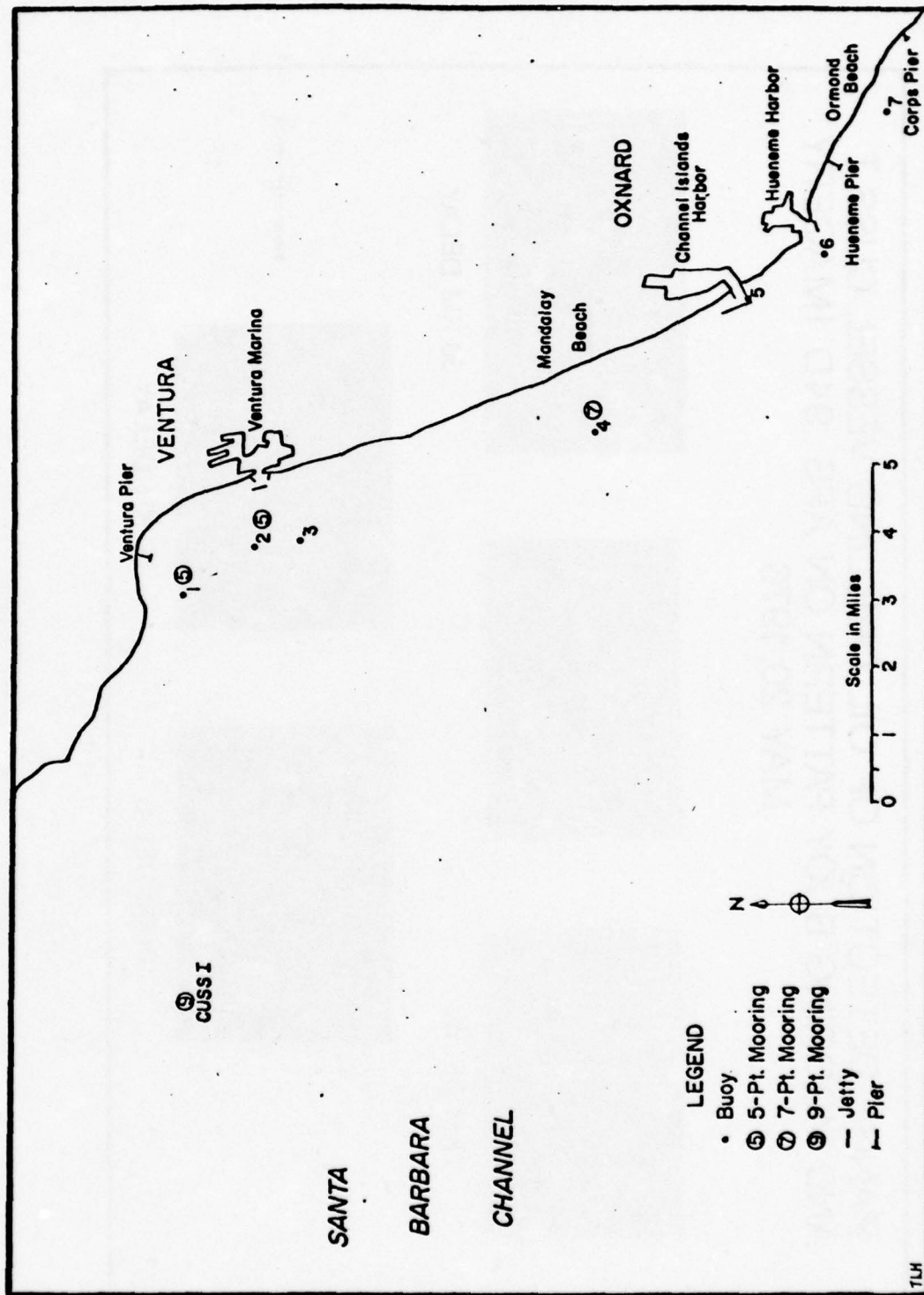
FIGURE 3



APS-94D COR
COMPARISON OF APS-94D AND COR FOR DETECTION OF MAN-MADE TARGETS

Photographs show area of Santa Barbara Channel from Hope Ranch west to Capitan. Imaged concurrently by APS-94D and COR during Run 6, May 19, 1976. Range for both radars was 0-25 km. Operating mode for APS-94D was overland; COR was set for overwater. Known targets include: (A) 35' cabin cruiser off Naples Reef; (B) 2,000' long Elwood oil support pier; (C) 61' aluminum crewboat MALLARD; (D) 83' wooden ocean tug CONTENDER; (E) abandoned concrete and steel pier piling; (F) marker buoy with radar reflector; (G) 5-point tanker mooring at Coal Oil Point; (H) 61' steel crewboat JUNE TIDE underway; (I) oil drilling platform HOLLY; (J) 40' sailboat underway; (K) 83' steel USCGC PT. JUDITH underway; (L) 1,000'Goleta Pier; (M) 25' sailboat; and, (N) 22 x 12' live bait float. Targets not detected by COR located at (A), (F), (M), and (N). Those at (C), (D), and (E) on COR are extremely difficult to differentiate from background return of kelp beds.

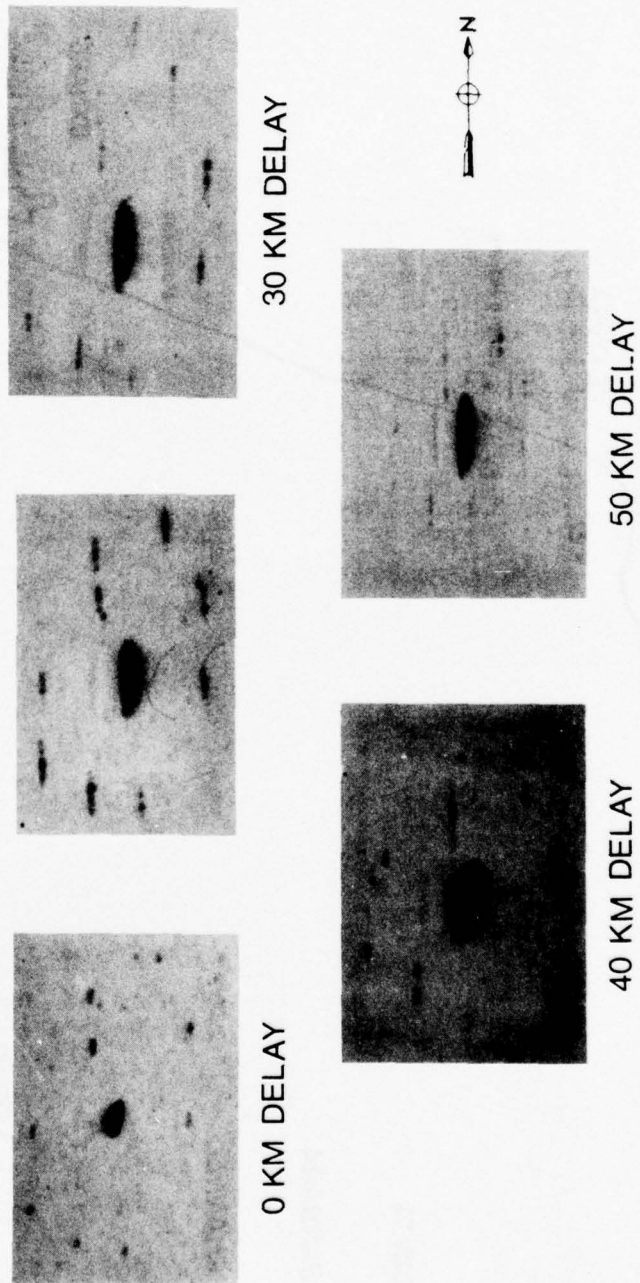
FIGURE 4



OXNARD-VENTURA-PORT HUENEME TEST AREA

FIGURE 5

RANGE DETECTION OF OIL DRILLING VESSEL CUSS I
AND MOORING BUOY PATTERN ON APS - 94D IMAGERY
MAY 20, 1976



of image quality as distance increases (see Target Resolution subsection for a discussion of this characteristic).

MORRO BAY (May 21, 1976)

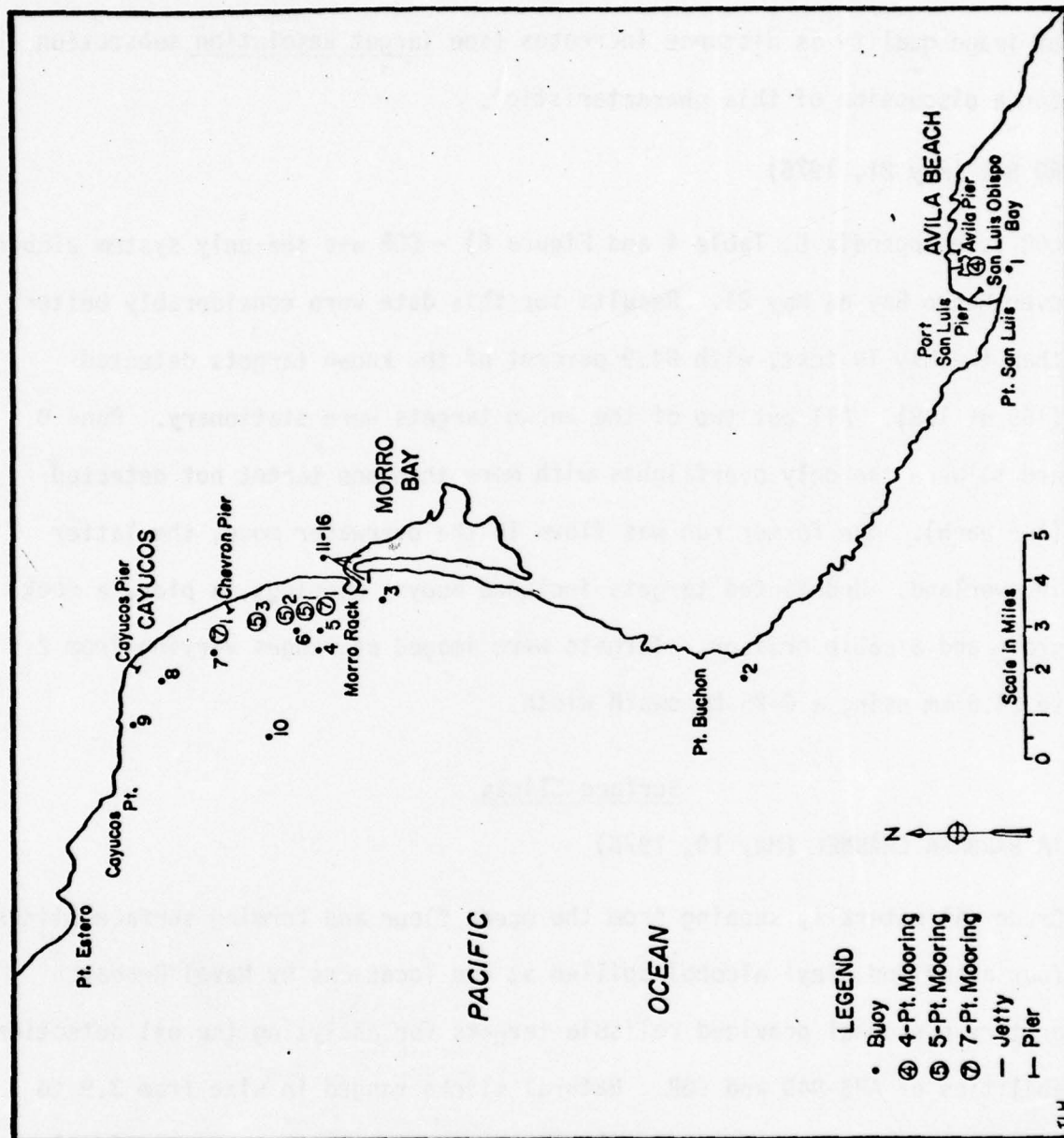
- COR (see Appendix B, Table 4 and Figure 6) - COR was the only system airborne over Morro Bay on May 21. Results for this date were considerably better than the May 19 test, with 94.9 percent of the known targets detected (169 of 178). All but two of the known targets were stationary. Runs 8 and 11 were the only overflights with more than one target not detected (two each). The former run was flown in the overwater mode, the latter in overland. Undetected targets included buoys, moorings, a pier, a rock groin and a cabin cruiser. Targets were imaged at ranges varying from 2.5 km to 24.6 km using a 0-25 km swath width.

Surface Slicks

SANTA BARBARA CHANNEL (May 19, 1976)

Crude oil naturally seeping from the ocean floor and forming surface slicks in four areas and oleyl alcohol spilled at two locations by Naval Research Laboratory personnel provided reliable targets for analyzing the oil detection capabilities of APS-94D and COR. Natural slicks ranged in size from 3.9 to 6.0 square miles. The simulated oil slicks, created by the controlled release of small quantities of oleyl alcohol from the USCG cutter PT. JUDITH, were estimated at 80 x 120 feet and 2.25 miles x 300 feet. Wind direction during the tests was 220° at ten knots; swell direction was 270° with three foot waves. These conditions were considered favorable for the radar tests. Under such conditions the surface roughness of non-oil areas theoretically should provide

FIGURE 6

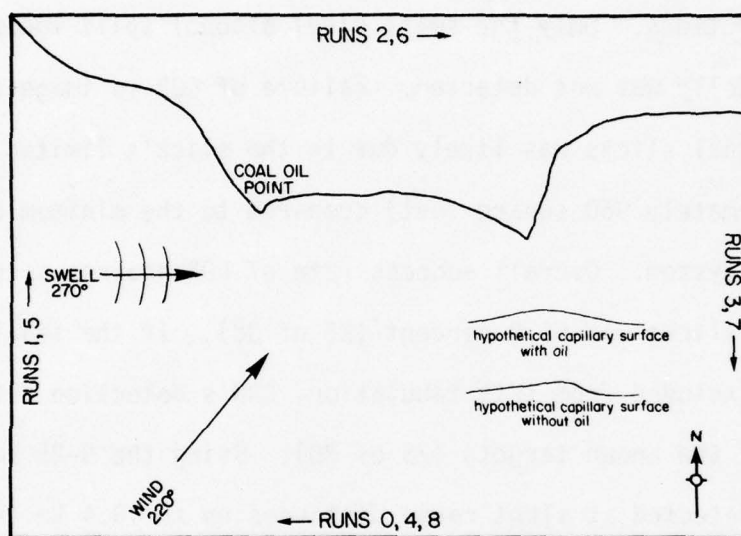


MORRO BAY TEST AREA

good backscattering compared to oil covered areas where a dampening or flattening effect on capillary waves reduces surface returns (see sketch map Figure 7).

- COR (see Appendix B, Table 2) - the COR consistently detected surface slicks associated with natural oil seepage and the long oleyl alcohol spill from all look directions. Only the small oleyl alcohol spill located southwest of platform Holly was not detected. Failure of COR to image the smaller of the two artificial slicks was likely due to the slick's limited surface area (i.e. approximately 960 square feet) compared to the minimum cell size resolution of the system. Overall success rate of COR against actual and simulated surface slicks was 65.8 percent (25 of 38). If the small oleyl alcohol spill is excluded from this tabulation, COR's detection rate increases to 83.3 percent of the known targets (25 of 30). Using the 0-25 km range setting, oil was detected at slant range distances up to 18.4 km from the sensor aircraft. With a 20 km delay (20-45 km range setting) in effect, the maximum slant range distance at which oil was imaged was 26.1 km. With the exception of Run 4, the vertically polarized COR synthetic aperture system provided excellent contrast between both the detectable natural and artificial surface slicks and the ocean surface. Figure 8 illustrates the oil detection capability of COR using imagery from Runs 6 and 7.
- APS-94D (see Appendix B, Table 1) - the horizontally polarized APS-94D real aperture radar was less successful than COR in the detection of natural and artificial surface slicks. Whereas COR detected slightly more than 65 percent of the known slicks, APS-94D imaged only 28.9 percent (11 of 38).

FIGURE 7



Sketch map depicting approximate wind and swell directions in the western Santa Barbara Channel, May 19, 1976. Look direction from APS-94D and COR perpendicular and to the right of the aircraft flight direction for each run.

FIGURE 8

— Flight Direction —→



Run 6

Run 7

SURFACE SLICKS DETECTED BY COR (May 19, 1976)

Run 6 - Flown from west to east looking south toward Santa Barbara Channel. Range 0-25 km using the overwater mode. Three distinct natural seep oil slicks are visible (A, B, and C). Long slick from oleyl alcohol spill (D) being released behind 83' USCG Cutter PT. JUDITH (E) barely discernable. Slant range distances to oil slicks at (C), (B), and (A) are 11.5 km, 14.2 km, and 15.1 km respectively. Distance to PT. JUDITH is approximately 16.5 km.

Run 7 - Flown from north to south looking west. Range 0-25 km using the overland mode. Natural seep visible at (A), (B), and (C); long oleyl alcohol spill at (D). Slant range distances to (A)(B)(D) and (C) are 4.7 km, 12.2 km, 17.7 km, and 14.0 km, respectively. PT. JUDITH (E), underway at 6 knots, not detected in overland mode. Note poor return and lack of contrast in lower half of photo.

The small oleyl alcohol slick was not detected. In contrast to COR, APS-94D appeared to be extremely dependent on look direction for the detection of oil. During the May 19 test, Runs 3 and 7 were the only overflights which provided good contrast between oil and water. Not surprisingly, they also were the only runs where the real aperture system was comparable to COR in the accurate detection of oil. The look direction on both of these runs (3 and 7) was into the swell and somewhat across the surface wind direction. The eight remaining runs were flown with the look direction either perpendicular to or with the swell direction (Figure 7). No oil was detected on Runs 0, 1, 4, 5, 6, and 9 and only limited success was achieved on Runs 2 and 8. Figure 9 compares APS-94D images for Runs 6 and 7.

From the limited sampling data available, it cannot be determined at this time whether the inability of APS-94D to consistently detect surface slicks in the western Santa Barbara Channel was due to the horizontal polarization of the APS-94D antenna, incorrect gain settings, or a combination of these factors. Further overwater flight tests involving the APS-94D, are recommended including using antennas of different sizes and, testing of horizontal and vertical polarizations under a variety of gain settings to document optimum detection characteristics for oil targets.

OXNARD-VENTURA-PORT HUENEME (May 20, 1976)

- APS-94D (see Appendix B, Table 3) - no surface oil was detected in the flight test area.

MORRO BAY (May 21, 1976)

- COR (see Appendix B, Table 4) - although small areas of natural seepage were observed in the area off Morro Rock during the ground truth flight, and Naval

FIGURE 9

— Flight Direction —→



Run 6

Run 7

COMPARISON OF APS-94D OIL DETECTION PERFORMANCE FROM TWO LOOK DIRECTIONS (May 19, 1976)

Run 6 - Flown from west to east looking south over the Santa Barbara Channel. Range 0-25 km in the overland mode. Three natural seep-related oil slicks at (A), (B), and (C) and oily alcohol simulated oil slick (D) behind the USCG Cutter PT. JUDITH (E) not detected. APS-94D looking perpendicular (across) swells coming from 270°.

Run 7 - Flown from north to south looking west. Range 0-25 km in the overland mode. Natural seep activity visible at (A), (B), and (C), as is artificial slick (D) created by release of oily alcohol from the PT. JUDITH (E). APS-94D looking directly into the swell direction. Slant range distances to (A), (B), (D), and (C) are 6.0 km, 13.5 km, 16.0-18.7 km, and 19.4 km, respectively.

Research Laboratory personnel released quantities of oleyl alcohol from the USCG Cutter CAPE HEDGE, no oil was conclusively detected on COR Runs 8-17. Surface conditions were smooth with wind velocity estimated at four knots (maximum) and swell height at one foot. It is probable that the lack of contrast between oil and non-oil areas resulted in COR's inability to detect surface slicks.

Target Resolution^{*}

A qualitative evaluation of the target resolution characteristics of APS-94D and COR was performed in conjunction with our analysis of target detection. This involved analyzing individual returns from known targets on each APS-94D and COR run, then ranking these target returns on a scale from poor to good. Criteria used in ranking included: (1) quality of the return (i.e. sharpness/ clarity), and (2) target contrast with background objects and/or the sea surface (see Appendix C, Explanatory Notes for a detailed explanation of the methodology used in ranking target returns and definitions of terms used in ranking system). General results of our target resolution performance evaluations are listed below.^{**} Data are arranged by date, system, and type of target:

^{*} Our evaluation of target resolution concentrated on assessing the sharpness and background contrast of APS-94D and COR radar returns from man-made and surface slick targets. Technical data on theoretical ground range and azimuth resolutions are contained in the Mororola, Inc. report.

^{**} See Appendix C, Parts I-III for detailed target resolution evaluations of APS-94D and COR on a run-by-run basis.

TABLE 2

Target Resolution Performance Evaluation

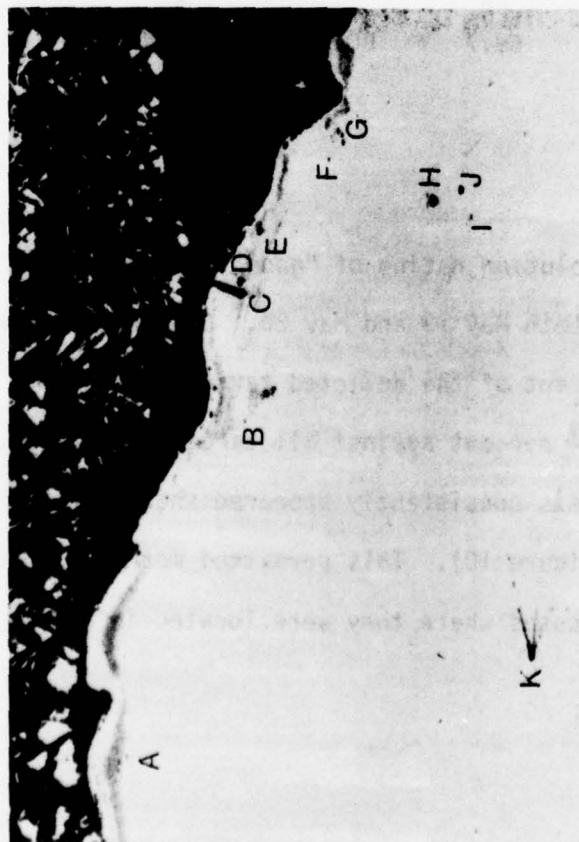
<u>General Target Type</u>	<u>APS-94D</u> <u>5/19/76</u>	<u>COR</u> <u>5/19/76</u>	<u>APS-94D</u> <u>5/20/76</u>	<u>COR</u> <u>5/21/76</u>
1. Man-Made				
Possible targets	163	162	96	178
No. ranked good	139	82	75	119
No. ranked fair	15	14	18	33
No. ranked poor	2	25	..	17
% detected targets ^A ranked good	89.1	67.8	80.6	70.4
2. Surface Slick				
Possible targets	38	38	..	2
No. ranked good	8	20	..	..
No. ranked fair	1	4	..	..
No. ranked poor	2	1	..	..
% detected targets ranked good	72.7	80.0	..	..
3. All Targets				
Possible targets	167	146	93	169
No. ranked good	147	102	75	119
No. ranked fair	16	18	18	33
No. ranked poor	4	26	..	17
% detected targets ranked good	88.0	69.7	80.6	70.4

^A Excludes targets not detected.

Overall, APS-94D achieved a target resolution rating of "good" for over 80 percent of the targets detected on both May 19 and May 20. Conversely, COR was rated "good" against only 69.7 percent of the detected targets during the May 19 coincident overflights, and 70.4 percent against all targets on May 21. Interpreted returns from man-made targets consistently appeared sharper on APS-94D imagery compared to COR (see Figure 10). This permitted more reliable discrimination of multiple targets in cases where they were located in close

FIGURE 10

— Flight Direction —→



APS-94D

COMPARISON OF TARGET RESOLUTION PERFORMANCE: APS-94D AND COR (May 19, 1976)

COR



Photographs show the offshore area from Coal Oil Point west to Capitan. Imaged by APS-94D (left) and COR (right) during Run 2 of the May 19, 1976 coincident overflights. Range for both radars 0-25 km. APS-94D operating in the overland mode; COR is the overwater mode. Targets include: (A) 5-point tanker mooring off Capitan; (B) small cabin cruiser (235'); (C) 2,000' Elwood Pier; (D) 83' wooden ocean tug CONTENDER and 61' aluminum oil crewboat MALLARD anchored 30-40 meters apart; (E) abandoned concrete pier pilings; (F) marker buoy with radar reflector; (G) 5-point tanker mooring off Coal Oil Pt. with small center buoy; (H) oil drilling platform HOLLY; (I) 16 sq. ft. plastic and wooden float with radar reflector; (J) 83' USCG Cutter PT. JUDITH; and, (K) 75' wooden ocean tug underway. Note the sharpness and clarity of targets on the APS-94D compared to COR. Several targets detected by APS-94D not recorded by COR (A and F); others tend to blend into background on the latter (B, D, E, and G), making detection more difficult for the image analyst.

↑
F
l
i
g
h
t

D
i
r
e
c
t
i
o
n

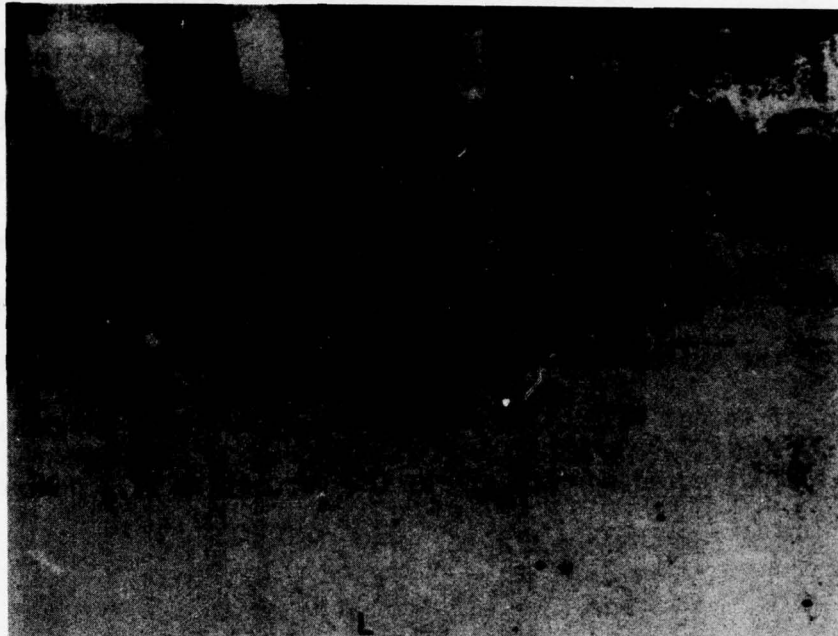


FIGURE 11

TARGET RESOLUTION OF COR IN THE OVERLAND MODE (May 21, 1976)

Photograph shows enlargement of image from Run 12 flown over Morro Bay on May 21, 1976. Range was 0-25 km. Targets identified on this image include: (A) Buoy #3 southeast of Morro Rock; (B) Buoy #5; (C) Buoy #4; (D) 7-point tanker mooring #1; (F) 5-point tanker mooring #2; (G) 5-point tanker mooring #3; (H) 1,200' long Chevron oil pier, (I) 7-point tanker mooring #2; (J) Buoy #7; (K) Buoy #8, southeast of Cayucos Pier (not pictured); and (L) Buoy #10. Note sharpness of man-made targets with the overland mode. Individual floats within the tanker moorings are visible.

proximity to one another (e.g. individual floats in a 5-point tanker mooring), or targets in areas with high background reflectance (e.g. within or adjacent to kelp beds). Conversely, COR often merged closely spaced man-made targets making it difficult or impossible for an interpreter to discriminate individual targets from other background returns. This reduced detection/resolution may have been a function of gain, mode setting and the multiple look features of COR, however. For example, while surface targets on COR imagery tended to merge when the overwater mode was used (Figure 10), good target discrimination was achieved when the system was switched to the overland mode (Figure 11).

In terms of target resolution performance, COR proved slightly better than APS-94D against detected surface slicks (80 percent to 72.7 percent).

CONCLUSIONS

Our major findings may be summarized as follows:*

- * Detection of Man-made targets - APS-94D consistently detected man-made targets (fixed and moving) from a variety of look directions and ranges. COR failed to image a number of targets detected by APS-94D, although overall target detection reliability was relatively consistent.
- * Detection of surface slicks - COR detected surface concentrations of natural seep oil from all look directions when sea states provided sufficient contrast between oil covered and open water returns. APS-94D detected oil only when the system was looking approximately into the direction of wind and wave movement.

* It should be noted that the conclusions drawn in this report are based on an analysis of less than twenty imagery runs by each system; only ten of which were flown concurrently. Because of this we emphasize that our summary conclusions should be regarded as preliminary and only used as supplemental inputs to any decision-making process. It is not the intention of GRSU researchers, based on these limited data, to make final recommendations as to which system would best fulfill the Coast Guard's offshore airborne surveillance requirements.

- * Resolution - Target returns on APS-94D imagery were consistently sharper than those on COR. This permitted reliable discrimination of multiple targets in close proximity to one another or targets in areas with high background reflectance. Conversely, COR often merged closely spaced individual targets and failed to discriminate individual targets from other background returns.
- * Although data derived from the flight test program answer many questions concerning the offshore target detection capabilities and target resolution characteristics of APS-94D and COR, a number of basic questions remain, including:
 - The reasons for non-detection of oil by APS-94D except when looking into the swell direction.
 - Documentation of factors affecting detection of moving targets by COR when operating in the overland mode.
 - Determination of optimum and maximum detection ranges of both systems for man-made and natural surface targets under a variety of sea states and operating conditions.

APPENDIX A

TARGET INFORMATION AND REPRESENTATIVE PHOTOGRAPHS

Section A provides statistical data for known targets in each of the three test areas. Moving targets were identified using field verification aerial photography flown by the Geography Remote Sensing Unit May 19-21, 1976. Fixed targets were located and identified from aerial photography, NOAA navigation charts, and USGS topographical quadrangle maps. Statistical data for fixed targets were obtained through direct contacts with representatives of federal, state, and local government and private companies. Ship dimensions were extracted from the U.S. Coast Guard's Publication CG-408 Merchant Vessels of the United States (1974 ed.) or estimates based on aerial photography and field observations.

EXPLANATORY NOTES

Target - refers to the type of target

Location - approximate location of the target (use with area reference maps:

Figure 2 - western Santa Barbara Channel; Figure 4 - Oxnard-Ventura-Port Hueneme offshore; Figure 6 - Morro Bay).

Dimensions - for calculating radar cross-sections. Normally listed in feet (man-made targets) or square miles (surface slicks).

Composition - Material composition of the target. A - aluminum, C - concrete, F - Fibreglass, P - plastic, R - rock, S - steel, and W - wood.

I. Targets Identified in the Western Santa Barbara Channel - May 19, 1976 (see Figure 2)

<u>Target</u>	<u>Location</u>	<u>Dimensions (≈)</u>	<u>Comp.</u>	<u>Remarks</u>
		BUOYS, FLOATS, AND MOORINGS		
Buoys	Various	Generally 4-8' high	S	Three in local area
Float, U.S. Coast Guard	SW of HOLLY	4' X 4' X 2 1/2'	P+W	Radar reflector
Float, Live Bait	Off Goleta Pier	22' X 12' X 3'	S+W	Wood surface/steel floats
Floats, Positioning	SW of Capitan	45' X 18' x 4'	S	Temporary; installed by Exxon Corp.
Floats, Tanker Mooring	Various	8-12' X 3-4'	S	Five to seven individual floats in each mooring
Mooring, Positioning	SW of Capitan	. . . .	S	Eight 45' X 18' floats located 1,000-2,000' apart; marking location of new oil drilling platform.
Mooring, Tanker	Various	. . . .	S	Located off Casitas Pier (7-point), Coal Oil Pt. (5-point), and Capitan (5-point). Floats normally spaced 200-600' apart in a semicircle.
		PIERS, PILINGS, ROCK GROINS, AND BREAKWATERS		
Pier (Biltmore)	SE of Santa Barbara	500' X 30' X 20'	W	
Pier (Casitas)	SE of Carpinteria	750' X 40' (Max.) X 25'	C+W	Causeway 600' X 20'; finger 150' X 40'
Pier (Ellwood)	S of Ellwood	2,000' X 160' (Max.) X 25'	W	Causeway 1,900' X 15'; finger 100' X 160'
Pier (Goleta)	S of Goleta	1,000' X 30' (Max.) x 20'	W	Causeway 950' X 18'; finger 50' X 30'

<u>Target</u>	<u>Location</u>	<u>Dimensions (Appx.)</u>	<u>Comp.</u>	<u>Remarks</u>
	PIERS, PILINGS, ROCK GROINS, AND BREAKWATERS			
Pier (Stearns)	Santa Barbara	1,445' X 76' (Max.) X 16'	W	Causeway is 1,195' X 36' T-shaped work area is 250' X 76'
Pier support	E of Ellwood Pier	40' X 25' (Max.) X 20'	C+S	Abandoned oil pier support
	PLATFORMS			
Oil (HAZEL)	Off Summerland	110' X 110' X 95'*	S	Standard Oil of California
Oil (HEIDI)	Off Carpinteria	110' X 110' X 95'*	S	Standard Oil of California
Oil (HILDA)	Off Summerland	110' X 110' X 95'*	S	Standard Oil of California
Oil (HILLHOUSE)	Off Summerland	110' X 135' X 99'*	S	Sun Oil of California
Oil (HOGAN)	Off Carpinteria	121' X 125' X 99'*	S	Phillips Petroleum
Oil (HOLLY)	Off Coal Oil Point	80' X 125' X 84'*	S	Atlantic Richfield
Oil (HOPE)	Off Carpinteria	110' X 110' X 95'*	S	Standard Oil of California
Oil (HOUGHIN)	Off Carpinteria	123' X 125' X 89½'*	S	Phillips Petroleum
Oil (Union A)	Off Summerland	112' X 134' X 99'*	S	Union Oil
Oil (Union B)	Off Summerland	112' X 134' X 99'*	S	Union Oil
Sewer Pipelaying (SPIDER)	Off Santa Barbara	50' X 70' X 20'	S	Healy-Tibbits Construction
*Height from MLLW to top of helipad.				

SURFACE SLICKS

Alcohol, Oleyl	SW of HOLLY	80' X 120' (Max.)
"	SE of HOLLY	2.25 miles X 300'

<u>Target</u>	<u>Location</u>	<u>Dimensions (Appx.)</u>	<u>Comp.</u>	<u>Remarks</u>
SURFACE SLICKS				
Oil, Natural Seep	Union A to Santa Barbara	Not measured		Elongated slick
"	Off Hope Ranch	3.9 square miles		
"	Off Goleta Pier	4.4 square miles		
"	Off Coal Oil Point	6.0 square miles		
VESSELS				
Sailboat	SW of Goleta Pier - SW of HOLLY	40' X 10'	F or W	Name unknown
Sailboat	Off Goleta Pier	25' X 8'	F or W	Name unknown
Sailboat	Off Santa Barbara	30' X 9'	F or W	Name unknown
Catamaran	Off Santa Barbara	35' X 10'	F or W	Name unknown
Cabin cruiser	Off Naples Reef	30' X 9'	F or W	Name unknown
Sailing	Off Santa Barbara	116' X 25'	W	PILOT (Brotherhood of the Sun)
Oil crewboat	NE of HILLHOUSE	61' X 16'	A or S	Name unknown; operated by Tidewater Marine
Oil crewboat	N of HOPE	61' X 16'	A or S	Name unknown; operated by Tidewater Marine
Oil crewboat	NW of HOLLY	61' X 17'	S	JUNE TIDE (Tidewater Marine)
Oil crewboat	E of Ellwood Pier	61' X 16'	A	MALLARD (Crowley Launch & Tug)
Ocean tug	SW of HOLLY	75' X 18'	W	Name unknown; operated by Puget Sound Tug Co.

<u>Target</u>	<u>Location</u>	<u>Dimensions (Appx.)</u>	<u>Comp.</u>	<u>Remarks</u>
		<u>VESSELS (Cont.)</u>		
Ocean tug	E of Ellwood Pier	83' X 20'	W	CONTENDER (Crowley Launch & Tug)
Sand barge	Off Santa Barbara (inside kelp)	100' X 40'	S	Unnamed; operated by Healy-Tibbits Construction
Sand barge	Off Santa Barbara (outside kelp)	120' X 50'	S	Unnamed; operated by Healy-Tibbits Construction
Cutter	Off HOLLY	83' X 17'	S	PT. JUDITH (U.S. Coast Guard)

II. Targets Identified in the Oxnard - Port Hueneme - Ventura Offshore Area - May 20, 1976 (see Figure 4)

BUOYS, FLOATS AND MOORINGS

Buoys 1-7	Various	Generally 4-8' high	S	Several with radar reflectors
Floats, mooring	Various	8-12' X 3-4'	S	Located off Ventura Pier, Ventura Marina Mandalay Beach, and surrounding the CUSS I
Float, Coast Guard	Off Channel Islands Harbor	4' X 4' X 2 1/2'	P+W	Radar reflector
Mooring, Positioning (9-pt.)	W of Ventura	. . . .	S	Surrounding CUSS I
Mooring, Tanker (5-pt. and 7-pt.)	Various	. . . .	S	Located off Ventura Pier, Ventura Marina and Mandalay Beach. Floats normally spaced 200'-600' apart.

PIERS, PILINGS, ROCK GROINS, AND BREAKWATERS

Pier (Ventura)	Ventura	1700' X 40' X 20'	W	
Pier (Hueneme)	SE of Hueneme Harbor	850' X 200' (Max.) X 20'	W	Causeway is 800' X 15'; T-shaped, work area is 50' X 200'

<u>Target</u>	<u>Location</u>	<u>Dimensions (Appx.)</u>	<u>Comp.</u>	<u>Remarks</u>
	PIERS, PILINGS, ROCK GROINS, AND BREAKWATERS (Cont.)			
Pier (Corps)	SE of Hueneme Harbor	680' X 20' X 15'	W	U.S. Army Corps of Engineers
Breakwater	Off Ventura Marina	1,500' X 15' X 10'	R	
Breakwater	Off Channel Is. Harbor	2,300' X 15' X 10'	R	
Rock Groin	Hueneme Harbor	650' X 10' X 10'	R	
	VESSELS			
Sailboat	SE of Channel Is. Harbor	30' x 9'	F or W	Name unknown
Sailboat	Off Channel Is. Harbor	20' X 8'	F or W	Name unknown
Cabin cruiser	E of Channel Is. Harbor	30' X 9'	F or W	Name unknown
Cabin cruiser	SE of Channel Is. Harbor	35' X 10'	F or W	Name unknown
Cabin cruiser	SW of Channel Is. Harbor	30' X 9'	F or W	Name unknown
Fishing boat	SE of Channel Is. Harbor	65' X 24'	W	ESTRELLA (CISCO Landing)
Fishing boat	SE of Corps Pier - SE of Channel Is. Harbor	40' X 12'	W	Name unknown
Fishing Boat	SW of Channel Is. Harbor	40' X 12'	W	Name unknown

<u>Target</u>	<u>Location</u>	<u>Dimensions</u>	<u>Comp.</u>	<u>Remarks</u>
		VESSELS (Cont.)		
Utility craft	Inside Channel Is. Harbor Breakwater	36' X 11½'	A	Corps of Army Engineers LARC
Drone recovery	Off Ormond Beach	83' X 17½'	W	AVT attached to U.S. Navy PMR Pt. Mugu; x-USCG WPB
Oil crewboat	Off Hueneme Harbor	60½' X 16'	A	WARM TIDE (Tidewater Marine)
Oil workboat	Alongside CUSS I	142' X 35'	S	CALDWELL (Tidewater Marine)
Oil drilling	W of Ventura	259½' X 58'	S	CUSS I (Global Marine)
Cutter	Off Channel Is. Harbor	41' X 13'	A	U.S. Coast Guard
Cargo	Off Ormond Beach	637' X 82'	S	PRESIDENT TAFT (American President Lines)

III. Targets in the Morro Bay Area - May 21, 1976 (see Figure 6)

BUOYS, FLOATS, AND MOORINGS

Buoys 1-16	Various	Generally 4-8' high	S	Several with radar reflectors
Float, Tanker Mooring	Various	8-12' X 3-4'	S	Located in San Luis Obispo Bay; NW of Morro Rock, off Morro Beach, and SW and NW of Chevron Pier
Mooring, Tanker (4-pt., 5-pt. and 7-pt.)	Various	. . . .	S	Located in San Luis Obispo Bay (4-pt.), off Morro Beach (2-5-pt.), SW of Chevron Pier (5-pt.), NW of Morro Rock (7-pt.), and NW of Chevron Pier (7-pt.). For 4-pt. mooring, floats extend in straight line with 50-75' separation; for 5-pt. and 7-pt. moorings floats are 200'-600' apart in a semicircular pattern.

<u>Target</u>	<u>Location</u>	<u>Dimensions (Appx.)</u>	<u>Comp.</u>	<u>Remarks</u>
	PIERS, PILINGS, ROCK GROINS, AND BREAKWATERS			
Pier (Avila)	Avila Beach	1,635' X 20' X 30'	W	
Pier (Oil support)	SW of Avila	2,900' X 400' (Max.) X 20'	W	Causeway is 2,700' X 20'; finger is 200' X 400'
Pier (Port San Luis)	San Luis Obispo Bay	1,485' X 60' (Max.) X 25'	W	Causeway is 1,375' X 30'; finger is 110' X 60'
Pier (Chevron)	NW of Morro Rock	1,200' X 16' (Max.) X 30'	W	Causeway is 1,160' X 6'; finger is 40' X 16'
Pier (Cayucos)	Cayucos	952' X 20' X 18'	W	
Rock groin	Off Pt. San Luis	2,400' X 25' X 20'	R	
Rock groin	SE of Morro Rock	1,200' X 20' X 20'	R	
Rock groin	Adjacent to Morro Rock	1,820' X 20' X 20'	R	
VESSELS				
Cabin cruiser	SE of Morro Rock	35' X 10'	F or W	Name unknown
Cabin cruiser	SW of Morro Rock	30' X 9'	F or W	Name unknown
Cabin cruiser	Off Morro Rock	30' x 9'	F or W	Name unknown
Cabin cruiser	SE of Morro Rock	25' X 8'	F or W	Name unknown
Fishing boat	SE of Morro Rock	50' X 15'	W	Name unknown
Fishing boat	SE of Morro Rock	40' X 12'	W	Name unknown
Fishing boat	Off Morro Rock	40' X 12'	W	Name unknown
Fishing boat	Off Morro Rock	35' X 10'	W	Name unknown
Cutter	Off Morro Rock	95' X 19'	S	CAPE HEDGE (U.S. Coast Guard)

Section B - Representative Photographs

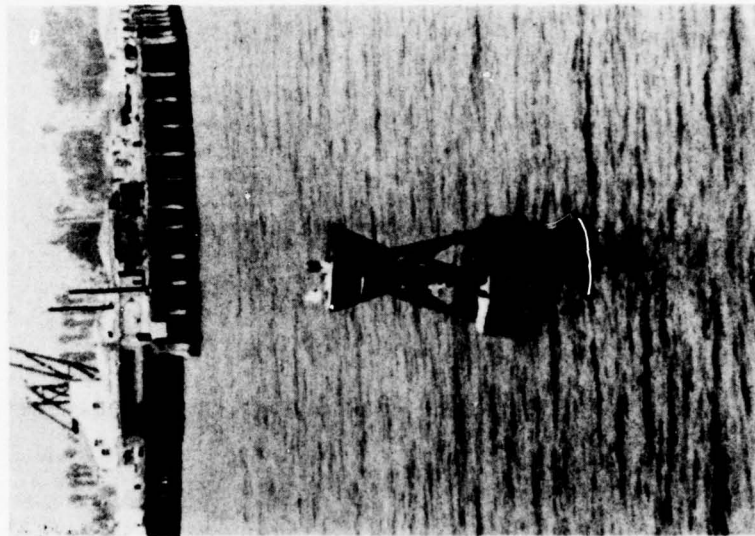
- I. Buoys, Floats, and Moorings
- II. Piers, Pilings, Rock Groins, and Breakwaters
- III. Platforms
- IV. Surface Slicks
- V. Vessels

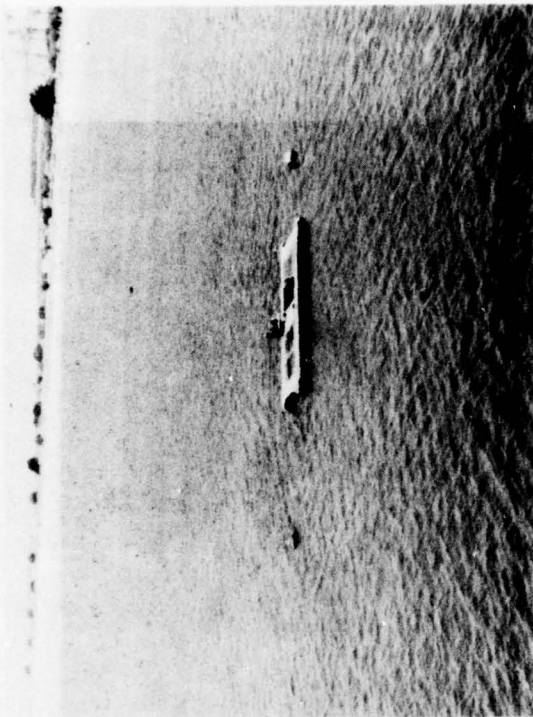
I. BUOYS, FLOATS AND MOORINGS



Small marker buoy with radar corner reflectors.
Located west of the Burmah Oil 5-point tanker
mooring off Coal Oil Point. Photographed
June 17, 1976

Navigation buoy located near the entrance
to Santa Barbara Harbor. The steel construc-
tion buoy is equipped with radar corner
reflectors. Photographed June 17, 1976.





Top left- Metal positioning float with radar reflector. One of eight temporary floats anchored SW of Capitan to mark the location of a new Exxon oil drilling platform. Photographed June 17, 1976.

Top right- Live bait float anchored off Goleta Pier. Float is of wood construction with steel reinforcement along the sides. Photographed June 17, 1976.

Bottom left- Small wood and plastic float with radar reflector. Used by the Coast Guard as a calibration target off Platform Holly on May 19 and Channel Islands Harbor on May 20. Photographed May 20, 1976.

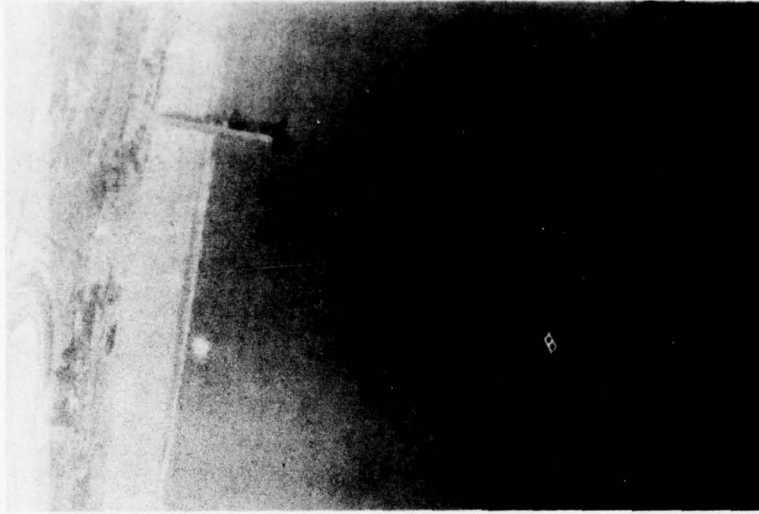
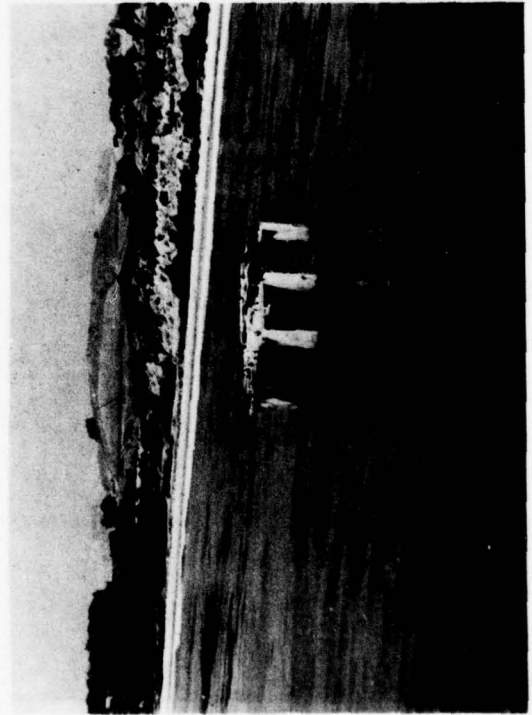
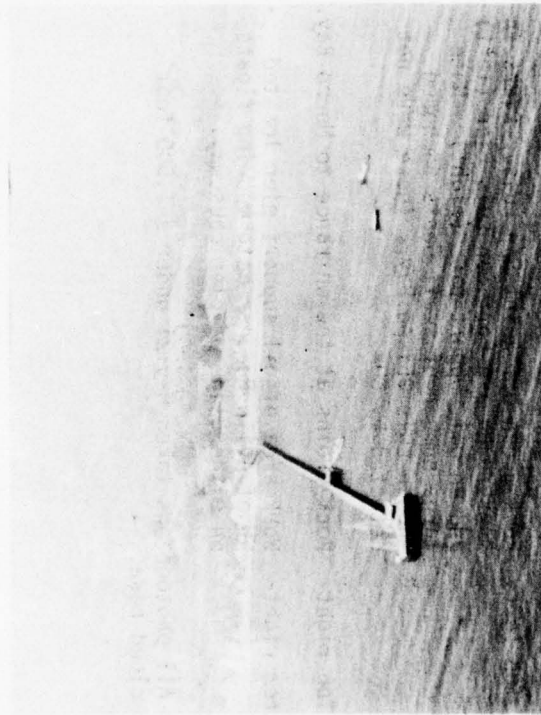


Seven point tanker mooring located NW of Morro Rock. Metal floats are spaced approximately 100-150 feet apart. Photographed May 21, 1976 under low clouds.



Close up view of individual mooring float within 5-point tanker mooring off Coal Oil Point. Photographed June 17, 1976.

II. PIERS, PILINGS, ROCK GROINS AND BREAKWATERS



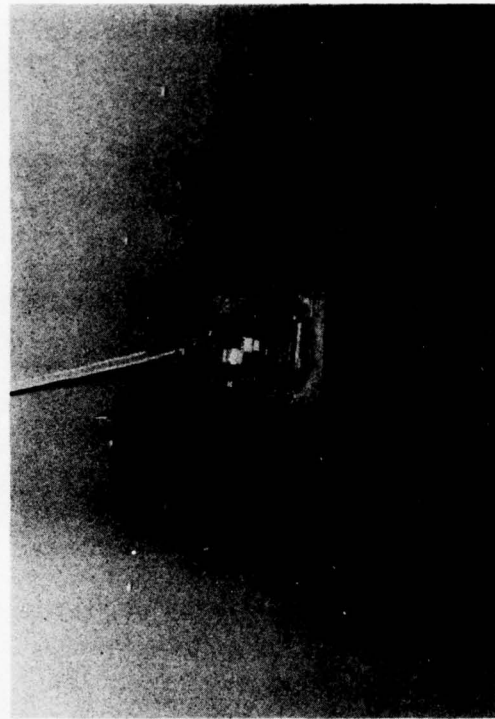
Top left- 2,000 foot long Elwood Pier located south of Elwood. Oil support vessels in the photograph are the crewboats JUNE TIDE (left) and MALLARD (center) and the ocean tug CONTENDER (right). Photographed May 19, 1976 through heavy haze.

Top right- Goleta Pier. Photographed May 19, 1976.

Bottom left- Abandoned concrete pier support east of Elwood Pier. Photographed June 17, 1976.



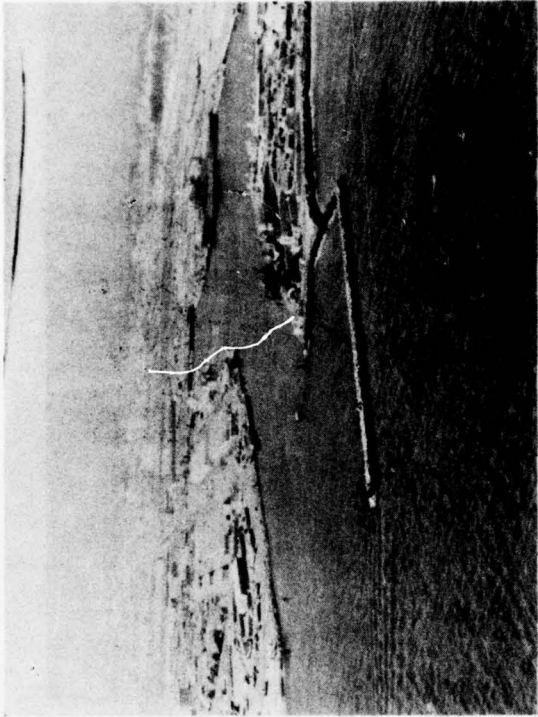
Top left- Rock groin off Point San Luis. Piers in background are Port San Luis Pier (left) and an oil support pier (right). Note large number of small boats anchored in San Luis Obispo Bay. These were not detected by COR.



Top right- Rock groins at the entrance to Morro Bay.

Bottom right- Work area of oil support pier located NW of Avila Beach. Note mooring floats on either side of pier causeway.

All photographs taken May 21 under a 1,500 foot cloud base.

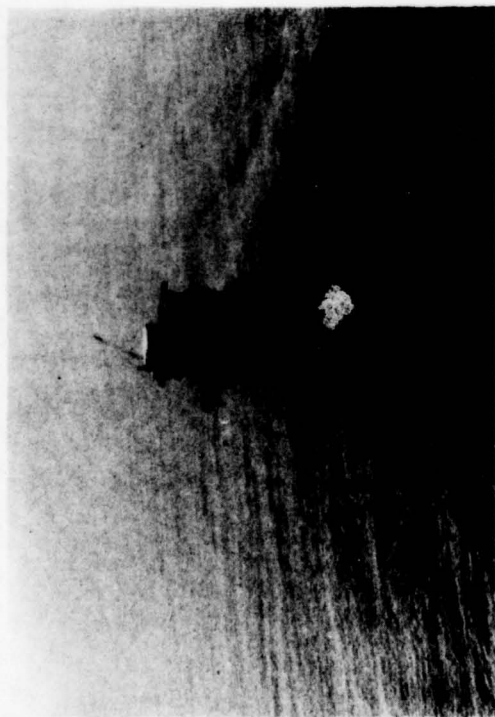


Top left- Channel Islands Harbor and breakwater.
Photographed in extremely hazy conditions
May 20, 1976.

Top right- Rock groin at the entrance to Hueneme
Harbor. Photographed May 20, 1976.

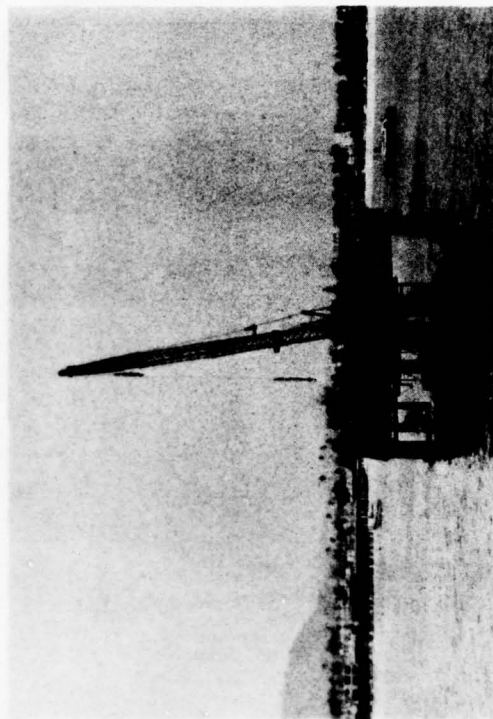
Bottom left- Santa Barbara Yacht Harbor and Stearns
Wharf (center). Photographed May 19, 1976

III. PLATFORMS

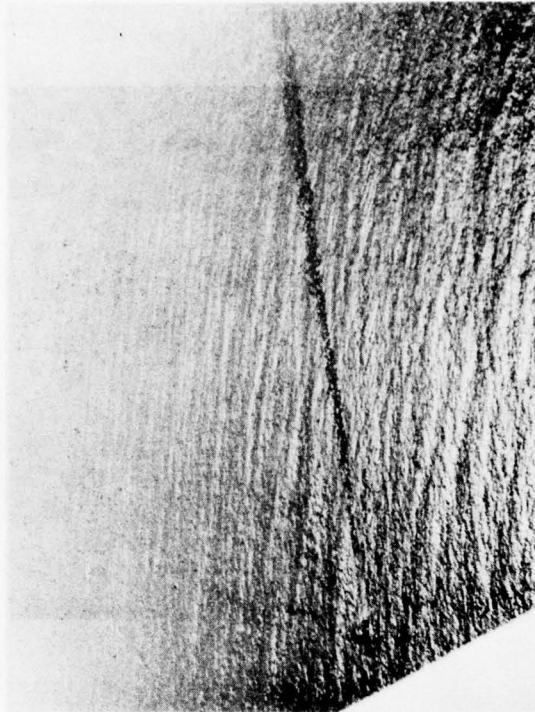
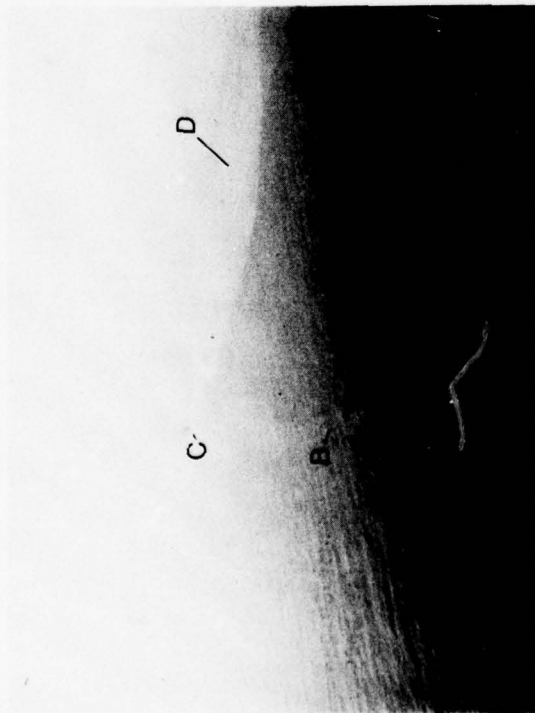


Healy Tibbits Construction Co.'s hydraulic platform SPIDER laying sewer pipeline east of Stearns Wharf (Santa Barbara). Photographed June 17, 1976.

Oil drilling platform HOLLY. Located off Coal Oil Point, HOLLY is operated by Atlantic Richfield Company. Photographed June 17, 1976.



IV. SURFACE SLICKS



Top left- Cutter PT. JUDITH (A) dumping oily alcohol (B) off Platform HOLLY (C). Photo taken May 19, 1976. Note large area of natural oil seepage (D) visible through the haze.

Top right- Broadside view of PT. JUDITH releasing oily alcohol over the stern.

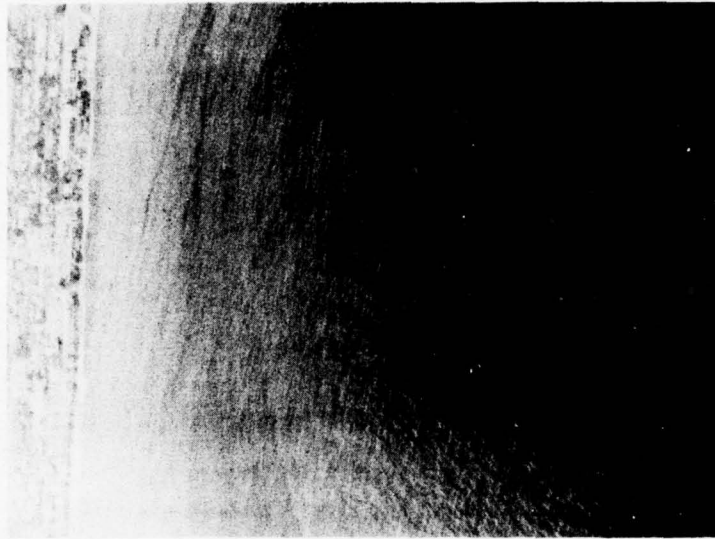
Bottom right- Small oily alcohol spill (A) with marker dye (B). Maximum area of the slick was approximately 100 feet x 60 feet. Slick was not observed on APS-94D or COR.

All photographs taken May 19, 1976.

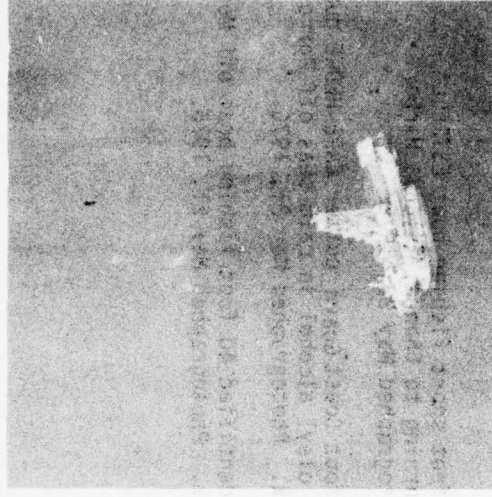


Seep oil surfacing just east of Coal Oil Point.
Photographed May 19, 1976.

Natural oil seeps off Coal Oil Point. Sun
glitter marks area of heavy surface concentra-
tion. Photographed May 19, 1976.



V. VESSELS



Top left-

Wooden-hulled ocean tug underway southwest of Platform HOLLY. Unidentified vessel is approximately 75 feet long. Photographed May 19, 1976.

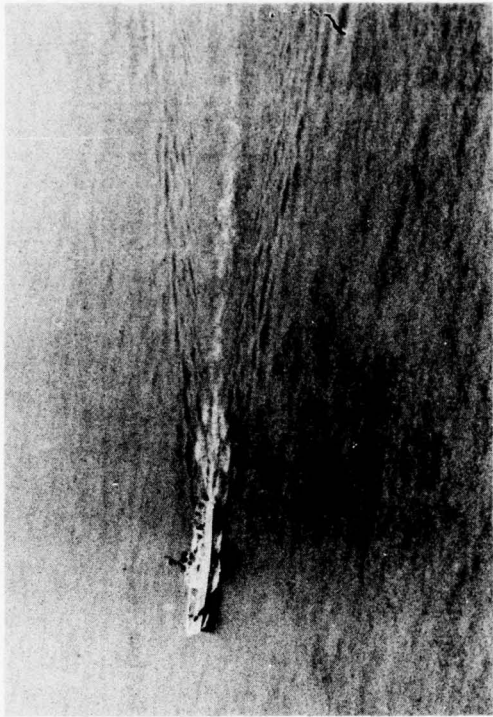
Top right-

Glomar Marine's 260 foot oil drilling ship CUSS I anchored approximately six miles southwest of Ventura. Tidewater Marine's 142 foot workboat CALDWELL is tied up alongside. Photographed May 20, 1976 through heavy haze.

Bottom left-

120 foot sand barge anchored off Santa Barbara. Note the sewer pipelaying platform in the background. Photographed June 17, 1976.

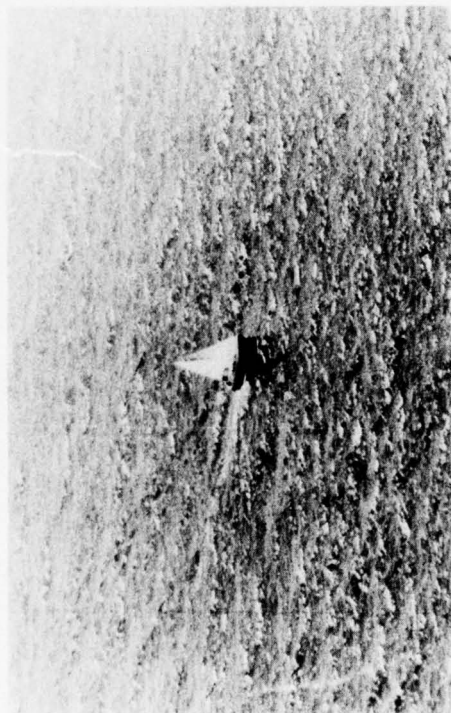




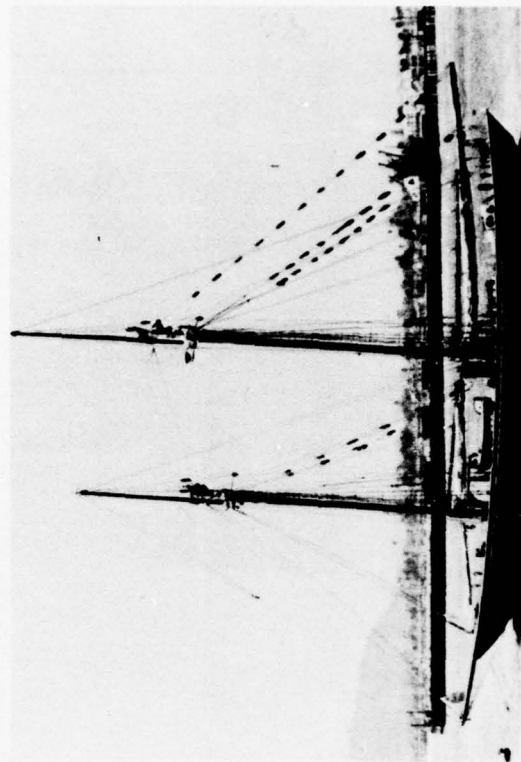
Top left- 65 foot sport fishing boat ESTRELLA returning to Channel Islands Harbor. Photographed May 20, 1976.

Top right- 95 foot Coast Guard cutter CAPE HEDGE dumping oily alcohol in calm seas off Morro Rock. Photographed May 21, 1976.

Bottom left- Unidentified 40 foot fishing boat off Morro Rock. Photographed May 21, 1976.



Sailboat underway off Channel Islands Harbor.
Photographed May 20, 1976



The two-masted sailing vessel PILOT anchored
east of Stearns Wharf (Santa Barbara).
Photographed June 17, 1976.

APPENDIX B
COMPREHENSIVE EVALUATION OF APS-94D
AND
COR FOR TARGET DETECTION
IN THE
SOUTHCENTRAL CALIFORNIA TEST AREA

TABLE 1

DETECTION OF MARINE AND NEARSHORE TARGETS IN THE SANTA BARBARA
CHANNEL BY REAL APERTURE (APS-94D) RADAR, MAY 19, 1976

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 0, 0-25 km (Aircraft Heading 273°)

BUOYS, FLOATS, AND MOORINGS

11.1-13.3 (6.9-8.2)	Marker buoys and Floats	SW of Capitan	S	X	Positioning floats for new Exxon platform; all 8 visible
12.5(7.8)	Coast Guard float	SW of Holly	W	X	Radar reflector
15.5(9.6)	7-point mooring	Off Casitas Pier	S	X	Tanker mooring floats
15.7(9.8)	5-point mooring	Off Coal Oil Pt.	S	X	Tanker mooring floats
16.0(10.0)	Marker buoy	SW of Coal Oil Pt.	S	X	Radar reflector
16.0(10.0)	Navigation buoy	Off Santa Barbara	S	X	Outer harbor buoy
16.5(10.2)	Navigation buoy	Off Santa Barbara	S	X	Inner harbor buoy
16.5(10.2)	Live bait float	Off Goleta Pier	S+W	X	
20.2(12.5)	5-point mooring	Off Capitan	S	X	Tanker mooring floats

PIERS AND PILINGS

16.2(10.1)	Oil support (Casitas Pier)	SE of Carpinteria	C+S	X	
16.9(10.4)	Recreation (Stearns Wharf)	Santa Barbara	W	X	
17.0(10.5)	Recreation (Goleta Pier)	S of Goleta	W	X	
17.2(10.7)	Pier support	E of Ellwood Pier	C	X	Abandoned
17.7(11.0)	Private (Biltmore Pier)	E of Santa Barbara	W	X	
18.2(11.3)	Oil support (Ellwood Pier)	S of Ellwood	W	X	

PLATFORMS

8.6(5.3)	Oil drilling (HILLHOUSE)	Off Summerland	S	X	
8.9(5.5)	Oil drilling (UNION B)	Off Summerland	S	X	
9.1(5.6)	Oil drilling (UNION A)	Off Summerland	S	X	

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 0 (cont.)

10.1(6.3)	Oil drilling (HOUGHIN)	Off Carpinteria	S	X	
10.6(6.6)	Oil drilling (HOGAN)	Off Carpinteria	S	X	
10.8(6.7)	Oil drilling (HOPE)	Off Carpinteria	S	X	
11.3(7.0)	Oil drilling (HEIDI)	Off Carpinteria	S	X	
13.5(8.4)	Oil drilling (HOLLY)	Off Coal Oil Point	S	X	
15.0(9.3)	Oil drilling (HAZEL)	Off Summerland	S	X	
15.2(9.5)	Oil drilling (HILDA)	Off Summerland	S	X	
17.2(10.7)	Sewer pipe laying (SPIDER)	Off Santa Barbara	S	X	

SURFACE SLICKS

12.7(7.9)	Oil	Off Goleta Pier		X	Natural seep
12.8(7.9)	Oil	Offshore, between Summerland-Santa Barbara		X	Natural seep; origin near Platform A
13.4(8.3)	Oil	Off Hope Ranch		X	Natural seep
14.8(9.2)	Oil	Off Coal Oil Point		X	Natural seep

VESSELS

9.4(5.8)	Sailboat (unid.)	SW of Goleta Pier	F or W	X	Underway
10.3(6.4)	Oil crewboat (unid.)	NE of HILLHOUSE	A or S	X	Underway
10.3(6.4)	Ocean tug (unid.)	SW of HOLLY	W	X	Underway
12.1(7.5)	Oil crewboat (unid.)	N of HOPE	A or S	X	Underway
12.8(7.9)	Cutter (PT. JUDITH)	SE of Holly	S	X	Anchored
16.5(10.2)	Sailboat (unid.)	Off Goleta Pier	F or W	X	Anchored
16.7(10.4)	Cabin cruiser (unid.)	Off Naples Reef	F or W	X	Anchored
16.7(10.4)	Sailing vessel (PILOT)	Off Santa Barbara	F or W	X	Anchored
16.7(10.4)	Oil crewboat (JUNE TIDE)	NW of HOLLY	S	X	Underway

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 0 (cont.)

17.0(10.5)	Sailboat (unid.)	Off Santa Barbara	F or W	X	Anchored
17.0(10.5)	Catamaran (unid.)	Off Santa Barbara	F or W	X	Anchored
17.0(10.5)	Sand barge (unnamed)	Off Santa Barbara	S	X	Anchored outside kelp
17.1(10.6)	Sand barge (unnamed)	Off Santa Barbara	S	X	Anchored inside kelp
17.7(11.0)	Oil crewboat (MALLARD)	E of Ellwood Pier	A	X	Anchored near CONTENDER
17.7(11.0)	Ocean tug (CONTENDER)	E of Ellwood Pier	W	X	Anchored

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 1, 0-25 km (Aircraft Heading 351°)

BUOYS, FLOATS, AND MOORINGS

17.6(10.9)	Coast Guard float	SW of HOLLY	W	X	Radar reflector
19.5(12.1)	Marker buoy	SW of Coal Oil Pt.	S	X	Radar reflector
19.9(12.3)	5-point mooring	Off Coal Oil Pt.	S	X	Tanker mooring floats

PIERS AND PILINGS

16.7(10.4)	Oil support (Ellwood Pier)	S of Ellwood	W	X	
18.2(11.3)	Pier support	E of Ellwood Pier	C	X	Abandoned

PLATFORMS

18.2(11.3)	Oil drilling (HOLLY)	Off Coal Oil Pt.	S	X	
------------	----------------------	------------------	---	---	--

SURFACE SLICKS

17.3(10.7)	Oil alcohol	SW of HOLLY		X	Small artificial slick
17.5(10.8)	Oil	Off Coal Oil Pt.		X	Natural seep
23.8(14.8)	Oil	Off Goleta Pier		X	Natural seep

VESSELS

8.9(5.5)	Ocean tug (unid.)	SW of HOLLY	W	X	Underway
14.0(8.7)	Cabin cruiser (unid.)	Off Naples Reef	F or W	X	Anchored
17.0(10.5)	Oil crewboat (MALLARD)	E of Ellwood Pier	A	X	Anchored
17.0(10.5)	Ocean tug (CONTENDER)	E of Ellwood Pier	W	X	Anchored
17.7(11.0)	Oil crewboat (JUNE TIDE)	NW of HOLLY	S	X	Underway
18.3(11.4)	Cutter (PT. JUDITH)	SE of HOLLY	S	X	Anchored
21.6(13.4)	Sailboat (unid.)	SE of Coal Oil Pt.	F or W	X	Underway

Target A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 2, 0-25 km (Aircraft Heading 093°)

BUOYS, FLOATS, AND MOORINGS

9.8(6.1)	5-point mooring	Off Capitan	S	X	Tanker mooring floats
13.8(8.5)	Live bait float	Off Goleta Pier	S+W	X	
14.3(8.8)	Marker buoy	SW of Coal Oil Pt.	S	X	Radar reflector
14.5(9.0)	5-point mooring	Off Coal Oil Pt.	S	X	Tanker mooring floats
17.3(10.7)	Coast Guard float	SW of HOLLY	W	X	Radar reflector

PIERS AND PILINGS

12.1(7.5)	Oil support (Ellwood Pier)	S of Ellwood	W	X	
12.7(7.9)	Pier support	E of Ellwood Pier	C	X	Abandoned
13.2(8.2)	Recreation (Goleta Pier)	S of Goleta	W	X	

PLATFORMS

16.5(10.2)	Oil drilling (HOLLY)	Off Coal Oil Pt.	S	X	
------------	----------------------	------------------	---	---	--

SURFACE SLICKS

14.6(9.1)	Oil	Off Coal Oil Pt.		X	Natural seep
16.0(10.0)	Oil	Off Goleta Pier		X	Natural seep
16.1(10.0)	Oil	Off Hope Ranch		X	Natural seep
17.0(10.5)	Oil alcohol	SW of HOLLY		X	Small artificial slick

VESSELS

12.3(7.6)	Oil crewboat (MALLARD)	E of Ellwood Pier	A	X	Anchored near CONTENDER
12.3(7.6)	Ocean tug (CONTENDER)	E of Ellwood Pier	W	X	Anchored
12.8(7.9)	Cabin cruiser (unid.)	Off Naples Reef	F or W	X	Anchored
17.1(10.6)	Cutter (PT. JUDITH)	SE of HOLLY	S	X	Anchored
18.4(11.4)	Ocean tug (unid.)	SW of HOLLY	W	X	Underway
20.4(12.7)	Sailboat (unid.)	SE of Coal Oil Pt.	F or W	X	Underway

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 3, 0-25 km (Aircraft Heading 185°)

BUOYS, FLOATS, AND MOORINGS

13.3(8.2)	Live bait float	Off Goleta Pier	S+W	X	
18.7(11.6)	5-point mooring	Off Coal Oil Pt.	S	X	
19.2(11.9)	Marker buoy	SW of Coal Oil Pt.	S	X	Tanker mooring floats
20.4(12.7)	Coast Guard float	SW of HOLLY	W	X	Radar reflector- Radar reflector

PIERS AND PILINGS

13.3(8.2)	Recreation (Goleta Pier)	S of Goleta	W	X	
20.9(13.0)	Pier support	E of Ellwood Pier	C	X	Abandoned
22.4(13.9)	Oil support (Ellwood Pier)	S of Ellwood	W	X	

PLATFORMS

20.2(12.5)	Oil drilling (HOLLY)	Off Coal Oil Pt.	S	X	
------------	----------------------	------------------	---	---	--

SURFACE SLICKS

6.9(4.3)	Oil	Off Hope Ranch		X	Natural seep
14.3(8.8)	Oil	Off Goleta Pier		X	Natural seep
20.9(13.0)	Oil	Off Coal Oil Pt.		X	Natural seep
21.1(13.1)	Oil alcohol	SW of HOLLY		X	Small artificial slick

VESSELS

15.6(9.7)	Sailboat (unid.)	SE of Coal Oil Pt.	F or W	X	Underway
19.9(12.3)	Cutter (PT. JUDITH)	SE of HOLLY	S	X	Anchored
21.1(13.1)	Oil crewboat (JUNE TIDE)	NW of HOLLY	S	X	Underway
22.1(13.7)	Oil crewboat (MALLARD)	E of Ellwood Pier	A	X	Anchored
22.1(13.7)	Ocean tug (CONTENDER)	E of Ellwood Pier	W	X	Anchored
24.8(15.4)	Cabin cruiser (unid.)	Off Naples Reef	F or W	X	Anchored

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 4, 0-25 km (Aircraft Heading 269°)

BUOYS, FLOATS, AND MOORINGS

23.4(14.5)	5-point mooring	Off Coal Oil Pt.	S	X	Tanker mooring floats Radar reflector
23.5(14.6)	Marker buoy	SW of Coal Oil Pt.	S	X	
24.1(14.9)	Live bait float	Off Goleta Pier	S+W	X	

PIERS AND PILINGS

24.3(15.1)	Recreation (Goleta Pier)	S of Goleta	W	X	
------------	--------------------------	-------------	---	---	--

PLATFORMS

21.1(13.1)	Oil drilling (HOLLY)	Off Coal Oil Pt.	S	X	
------------	----------------------	------------------	---	---	--

SURFACE SLICKS

20.4(12.7)	Oil	Off Goleta Pier		X	Natural seep
20.9(13.0)	Oil alcohol	SW of HOLLY		X	Small artificial slick
23.0(14.3)	Oil	Off Coal Oil Pt.		X	Natural seep

VESSELS

20.4(12.7)	Cutter (PT. JUDITH)	S of HOLLY	S	X	Anchored
20.7(12.8)	Ocean tug (unid.)	SE OF Capitan	W	X	Underway
21.6(13.4)	Oil crewboat (JUNE TIDE)	NW of HOLLY	S	X	Underway
24.0(14.9)	Sailboat (unid.)	Off Coal Oil Pt.	F or W	X	Underway

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 5, 0-25 km (Aircraft Heading 351°)

BUOYS, FLOATS, AND MOORINGS

8.7(5.4)	5-point mooring	Off Capitan	S	X	Tanker mooring floats
21.9(13.6)	Marker buoy	SW of Coal Oil Pt.	S	X	Radar reflector
22.4(13.9)	5-point mooring	Off Coal Oil Pt.	S	X	Tanker mooring floats

PIERS AND PILINGS

18.9(11.7)	Oil support (Ellwood Pier)	S of Ellwood	W	X	Abandoned
20.4(12.7)	Pier support	E of Ellwood Pier	C	X	

PLATFORMS

20.8(12.9)	Oil drilling (HOLLY)	Off Coal Oil Pt.	S	X	
------------	----------------------	------------------	---	---	--

SURFACE SLICKS

19.8(12.3)	Oil alcohol	SW of HOLLY		X	Small artificial slick
19.9(12.3)	Oil	Off Coal Oil Pt.		X	Natural seep

VESSELS

15.9(9.8)	Cabin cruiser (unid.)	Off Naples Reef	F or W	X	Anchored
19.4(12.0)	Oil crewboat (MALLARD)	E of Ellwood Pier	A	X	Anchored near CONTENDER
19.4(12.0)	Ocean tug (CONTENDER)	E of Ellwood Pier	W	X	Anchored
20.7(12.8)	Sailboat (unid.)	S of HOLLY	F or W	X	Underway
22.9(14.2)	Cutter (PT. JUDITH)	SW of HOLLY	S	X	Underway

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 6, 0-25 km (Aircraft Heading 093°)

BUOYS, FLOATS, AND MOORINGS

12.8(7.9)	Live bait float	Off Goleta Pier	S+W	X	
12.8(7.9)	Marker buoy	SW of Coal Oil Pt.	S	X	Radar reflector
13.0(8.1)	5-point mooring	Off Coal Oil Pt.	S	X	Tanker mooring floats

PIERS AND PILINGS

10.3(6.4)	Oil support (Ellwood Pier)	S of Ellwood	W	X	
11.1(6.9)	Pier support	E of Ellwood Pier	C	X	Abandoned
12.4(7.7)	Recreation (Goleta Pier)	S of Goleta	W	X	

PLATFORMS

14.9(9.2)	Oil drilling (HOLLY)	Off Coal Oil Pt.	S	X	
-----------	----------------------	------------------	---	---	--

SURFACE SLICKS

12.8(7.9)	Oil	Off Coal Oil Pt.		X	Natural seep
15.2(9.5)	Oil	Off Goleta Pier		X	Natural seep
15.4-17.9	Oil alcohol	SE of HOLLY		X	Long artificial slick
(9.6-11.0)					
15.5(9.6)	Oil alcohol	SW of HOLLY		X	Small artificial slick
15.6(9.7)	Oil	Off Hope Ranch		X	Natural seep

VESSELS

10.5(6.5)	Cabin cruiser (unid.)	Off Naples Reef	F or W	X	Anchored
10.6(6.6)	Oil crewboat (MALLARD)	E of Ellwood Pier	A	X	Anchored near CONTENDER
10.6(6.6)	Ocean tug (CONTENDER)	E of Ellwood Pier	W	X	Anchored
14.6(9.1)	Oil crewboat (JUNE TIDE)	NW of HOLLY	S	X	Underway
17.6(10.9)	Sailboat (unid.)	SW of Coal Oil Pt.	F or W	X	Underway
18.7(11.6)	Cutter (PT. JUDITH)	SE of HOLLY	S	X	Underway

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 7, 0-25 km (Aircraft Heading 178°)

BUOYS, FLOATS, AND MOORINGS

12.2(7.6)	Live bait float	S of Goleta Pier	S+W	X	
17.6(10.9)	5-point mooring	Off Coal Oil Pt.	S	X	Tanker mooring floats
18.2(11.3)	Marker buoy	SW of Coal Oil Pt.	S	X	Radar reflector.

PIERS AND PILINGS

12.2(7.6)	Recreation (Goleta Pier)	S of Goleta	W	X	
19.8(12.3)	Pier support	E of Ellwood Pier	C	X	Abandoned
21.1(13.1)	Oil support (Ellwood Pier)	S of Ellwood	W	X	

PLATFORMS

19.3(12.0)	Oil drilling (HOLLY)	Off Coal Oil Pt.	S	X	
------------	----------------------	------------------	---	---	--

SURFACE SLICKS

6.0(3.7)	Oil	Off Hope Ranch		X	Natural seep
13.5(8.4)	Oil	Off Goleta Pier		X	Natural seep
16.0-18.7					
(10.0-11.6)	Oil alcohol	SE of HOLLY		X	Long artificial spill
19.4(12.0)	Oil	Off Coal Oil Pt.		X	Natural seep
20.2(12.5)	Oil alcohol	SW of HOLLY		X	Small artificial seep

VESSELS

14.5(9.0)	Cutter (PT. JUDITH)	SE of HOLLY	S	X	Underway
20.9(13.0)	Oil crewboat (MALLARD)	E of Ellwood Pier	A	X	Anchored near CONTENDER
20.9(13.0)	Ocean tug (CONTENDER)	E of Ellwood Pier	W	X	Anchored
22.1(13.7)	Sailboat (unid.)	SW of HOLLY	F or W	X	Underway
24.3(15.1)	Cabin cruiser (unid.)	Off Naples Reef	F or W	X	Anchored

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 8, 0-25 km (Aircraft Heading $\approx 265^\circ$)

BUOYS, FLOATS, AND MOORINGS

20.2(12.5)	5-point mooring	Off Coal Oil Pt.	S	X	Tanker mooring floats
20.5(12.7)	Marker buoy	SW of Coal Oil Pt.	S	X	Radar reflector
21.8-22.9 (13.5-14.2)	Marker buoy/floats	SW of Capitan	S	X	For new Exxon platform; 3 buoys visible

PIERS AND PILINGS

22.4(13.9)	Pier support	E of Ellwood Pier	C	X	Abandoned
23.4(14.5)	Oil support (Ellwood Pier)	S of Ellwood	W	X	

PLATFORMS

18.6(11.5)	Oil drilling (HOLLY)	Off Coal Oil Pt.	S	X	
------------	----------------------	------------------	---	---	--

SURFACE SLICKS

15.0-18.9 (9.3-11.7)	Oil alcohol	SE of HOLLY		X	Long artificial slick
18.2(11.3)	Oil alcohol	SW of HOLLY			
20.4(12.7)	Oil	Off Coal Oil Pt.		X	Small artificial slick Natural seep

VESSELS

17.0(10.5)	Sailboat (unid.)	SW of HOLLY	F or W	X	Underway
21.8(13.5)	Ocean tug (unid.)	SW of Capitan	W	X	Anchored
22.7(14.1)	Oil crewboat (JUNE TIDE)	NW of HOLLY	S	X	Underway
23.1(14.3)	Oil crewboat (MALLARD)	E of Ellwood Pier	A	X	Anchored near CONTENDER
23.1(14.3)	Ocean tug (CONTENDER)	E of Ellwood Pier	W	X	Anchored
23.6(14.6)	Cabin cruiser (unid.)	Off Naples Reef	F or W	X	Anchored

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 9, 0-50 Km (Aircraft Heading 360°)

BUOYS, FLOATS AND MOORINGS

23.7(14.7)	Marker buoy	SW of Coal Oil Pt.	S	X	Radar reflector
25.0(15.5)	5-point mooring	Off Coal Oil Pt.	S	X	Tanker mooring floats
28.7(17.8)	Live bait float	S of Goleta Pier	S&W	X	

PIERS AND PILINGS

19.6(12.2)	Oil support (Elwood Pier)	S of Elwood	W	X	
21.2(13.1)	Pier support	E of Elwood Pier	C	X	Abandoned
29.1(18.0)	Recreation (Goleta Pier)	S of Goleta	W	X	
42.9(26.6)	Recreation (Stearns Wharf)	Santa Barbara	W	X	
46.9(29.3)	Private (Biltmore Pier)	SE of Santa Barbara	W	X	

PLATFORMS

21.7(13.4)	Oil drilling (HOLLY)	Off Coal Oil Pt.	S	X	
43.7(27.1)	Sewer pipelayings (SPIDER)	Off Santa Barbara	S	X	
50.0(31.0)	Oil drilling (Union B)	Off Summerland	S	X	
50.8(31.5)	Oil drilling (Union A)	Off Summerland	S	X	

SURFACE SLICKS

18.6(11.6)	Oil alcohol	SW of Holly		X	Small artificial slick
19.0(11.9)	Oil	Off Coal Oil Pt.		X	Natural seep
24.0(15.0)	Oil alcohol	SE of Holly		X	Long artificial slick
28.0(17.5)	Oil	Off Goleta Pier		X	Natural seep
35.1(21.9)	Oil	Off Hope Ranch		X	Natural seep

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

VESSELS

15.5(9.7)	Sailboat (unid)	SW of Holly	F	X	Underway
19.9(12.3)	Oil crewboat (MALLARD)	E of Elwood Pier	A	X	Anchored near CONTENDER
19.9(12.3)	Ocean tug (CONTENDER)	E of Elwood Pier	W	X	Anchored
36.8(22.8)	Cutter (PT. JUDITH)	SW of Santa Barbara	S	X	Underway
43.7(27.1)	Sailing (PILOT)	Off Santa Barbara	W	X	Anchored
44.4(27.5)	Sand barge (unnamed)	Off Santa Barbara	S	X	Anchored inside kelp
44.4(27.5)	Sand barge (unnamed)	Off Santa Barbara	S	X	Anchored outside kelp

TABLE 2

DETECTION OF MARINA AND NEARSHORE TARGETS IN THE SANTA BARBARA CHANNEL
BY SYNTHETIC APERTURE (COR) RADAR, MAY 19, 1976

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks
RUN 0, 0-25 km (Aircraft Heading 273°; Overwater Mode)					
BUOYS, FLOATS, AND MOORINGS					
9.4-11.0 (5.9-6.8)	Marker buoys and floats	SW of Capitan	S	X	Marking site for new Exxon platform; 6 of 8 buoys visible
10.4(6.4)	Coast Guard float	SW of Holly	W	X	Radar reflector
13.3(8.2)	5-point mooring	Off Coal Oil Pt.	S	X	Tanker mooring floats
13.5(8.4)	7-point mooring	Off Casitas Pier	S	X	Tanker mooring floats
13.6(8.4)	Marker buoy	SW of Coal Oil Pt.	S	X	Radar reflector
13.6(8.4)	Navigation buoy	Off Santa Barbara	S	X	Outer harbor buoy
14.1(8.7)	Navigation buoy	Off Santa Barbara	S	X	Inner harbor buoy
14.1(8.7)	Live bait float	S of Goleta Pier	S+W	X	
17.7(11.0)	5-point mooring	Off Capitan	S	X	Tanker mooring floats
PIERS AND PILINGS					
14.0(8.7)	Oil support (Casitas Pier)	SE of Carpinteria	W	X	
14.9(9.2)	Recreation (Stearns Wharf)	Santa Barbara	W	X	
15.5(9.6)	Recreation (Goleta Pier)	S of Goleta	W	X	
15.6(9.7)	Private (Biltmore Pier)	E of Santa Barbara	W	X	
15.6(9.7)	Pier support	E of Ellwood Pier	C	X	Abandoned
15.6(9.7)	Oil support (Ellwood Pier)	S of Ellwood	W	X	
PLATFORMS					
7.1(4.4)	Oil drilling (Union A)	Off Summerland	S	X	
7.1(4.4)	Oil drilling (Union B)	Off Summerland	S	X	
7.1(4.4)	Oil drilling (HILLHOUSE)	Off Summerland	S	X	
8.3(8.3)	Oil drilling (HOUGHIN)	Off Carpinteria	S	X	
8.8(5.4)	Oil drilling (HOGAN)	Off Carpinteria	S	X	
9.2(5.7)	Oil drilling (HOPE)	Off Carpinteria	S	X	
9.6(5.9)	Oil drilling (HEIDI)	Off Carpinteria	S	X	

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 0 (cont.)

11.3(7.0)	Oil drilling (HOLLY)	Off Coal Oil Pt.	S	X	
13.0(8.1)	Oil drilling (HILDA)	Off Summerland	S	X	
13.3(8.2)	Oil drilling (HAZEL)	Off Summerland	S	X	
15.1(9.4)	Sewer pipelaying (SPIDER)	Off Santa Barbara	S	X	
SURFACE SLICKS					
11.0(6.8)	Oil	Off Goleta Pier		X	Natural seep
11.0(6.8)	Oil	Off Coal Oil Pt.		X	Natural seep
11.6(7.2)	Oil	Off Hope Ranch		X	Natural seep
11.9(7.4)	Oil	Off Union A		X	Natural seep

VESSELS

7.1(4.4)	Oil crewboat (unid.)	N of HILLHOUSE	A or S	X	Underway
7.2(4.4)	Sailboat (unid.)	SW of Goleta Pier	F or W	X	Underway
8.4(5.2)	Ocean tug (unid.)	SW of HOLLY	W	X	Underway
10.4(6.4)	Oil crewboat (unid.)	N of HEIDI	A or S	X	Underway
10.6(6.6)	Cutter (PT. JUDITH)	SE of HOLLY	S	X	Anchored
13.3(8.2)	Crewboat (JUNE TIDE)	NW of HOLLY	S	X	Underway
14.3(8.8)	Cabin cruiser (unnamed)	Off Naples Reef	F or W	X	Anchored
14.5(8.9)	Sailboat (unid.)	S of Goleta Pier	F or W	X	Anchored
14.6(9.0)	Sand barge (unnamed)	Off Santa Barbara	S	X	Outside kelp bed
14.7(9.1)	Sand barge (unnamed)	Off Santa Barbara	W	X	Inside kelp bed
14.7(9.1)	Sailing vessel (PILOT)	Off Santa Barbara	F or W	X	Anchored
14.8(9.2)	Catamaran (unid.)	Off Santa Barbara	F or W	X	Anchored
14.8(9.2)	Sailboat (unid.)	Off Santa Barbara	F or W	X	Anchored
15.2(9.4)	Crewboat (WALLARD)	E of Ellwood Pier	A	X	Anchored near
15.2(9.4)	Ocean tug (CONTENDER)	E of Ellwood Pier	W	X	CONTENDER

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 1, 0-25 km (Aircraft Heading 351°; Overwater Mode)

BUOYS, FLOATS, AND MOORINGS

14.9(9.2)	Coast Guard float	SW of HOLLY	W	X	Radar reflector
15.8(9.8)	Marker buoy	SW of Coal Oil Pt.	S	X	Radar reflector
17.9(11.1)	5-point mooring	Off Coal Oil Pt.	S	X	Tanker mooring floats

PIERS AND PILINGS

14.2(8.8)	Oil support (Ellwood Pier)	S of Ellwood	W	X	
15.6(9.7)	Pier support	E of Ellwood Pier	C	X	Abandoned
22.3(13.8)	Recreation (Goleta Pier)	S of Goleta	W	X	

PLATFORMS

15.6(9.7)	Oil drilling (HOLLY)	Off Coal Oil Pt.	S	X	
-----------	----------------------	------------------	---	---	--

SURFACE SLICKS

15.8(9.8)	Oil alcohol	SW of HOLLY			X	Small artificial slick
16.5(10.2)	Oil	Off Coal Oil Pt.		X		Natural seep
23.0(14.3)	Oil	Off Goleta Point			X	Natural seep

VESSELS

14.4(8.9)	Oil crewboat (MALLARD)	E of Ellwood Pier	A	X		Anchored near CONTENDER
14.4(8.9)	Ocean tug (CONTENDER)	E of Ellwood Pier	W	X		Anchored
15.2(9.4)	Oil crewboat (JUNE TIDE)	NW of HOLLY	S	X		Underway
15.6(9.7)	Cutter (PT. JUDITH)	SE of HOLLY	S	X		Anchored
18.4(11.4)	Sailboat (unid.)	SW of Goleta Pier	F or W	X		Underway

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 2, 0-25 km (Aircraft Heading 093°; Overwater Mode)

BUOYS, FLOATS, AND MOORINGS

11.9(7.4)	Live bait float	S of Goleta Pier	S+W	X	Radar reflector
12.3(7.6)	Marker buoy	SW of Coal Oil Pt.	S	X	Tanker mooring floats
12.6(7.8)	5-point mooring	Off Coal Oil Pt.	S	X	Radar reflector
15.1(9.4)	Coast Guard float	SW of HOLLY	W	X	

PIERS AND PILINGS

10.3(6.4)	Oil support (Ellwood Pier)	S of Ellwood	W	X	Abandoned
10.7(6.6)	Pier support	E of Ellwood Pier	C	X	
11.3(7.0)	Recreation (Goleta Pier)	S of Goleta	W	X	

PLATFORMS

14.4(8.9)	Oil drilling (HOLLY)	Off Coal Oil Pt.	S	X	
-----------	----------------------	------------------	---	---	--

SURFACE SLICKS

13.3(8.2)	Oil	Off Coal Oil Pt.		X	Natural seep
14.4(8.9)	Oil	Off Hope Ranch		X	Natural seep
15.0(9.3)	Oil alcohol	SW of HOLLY		X	Small artificial slick
15.1(9.4)	Oil	Off Goleta Pier		X	Natural seep

VESSELS

10.3(6.4)	Oil crewboat (MALLARD)	E of Ellwood Pier	A	X	Anchored near CONTENDER
10.3(6.4)	Ocean tug (CONTENDER)	E of Ellwood Pier	W	X	Anchored
11.0(6.8)	Cabin cruiser (unid.)	Off Naples Reef	F or W	X	Anchored
14.9(9.2)	Cutter (PT. JUDITH)	SE of HOLLY	S	X	Anchored
16.3(10.1)	Ocean tug (unid.)	SW of HOLLY	W	X	Underway
18.0(11.2)	Sailboat (unid.)	SE of Coal Oil Pt.	F or W	X	Underway

Target ^A					
Range ^B (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 3, 0-25 km (Aircraft Heading 185°)

BUOYS, FLOATS, AND MOORINGS

13.3(8.2)	Live bait float	Off Goleta Pier	S+W	X	
18.7(11.6)	5-point mooring	Off Coal Oil Pt.	S	X	
19.2(11.9)	Marker buoy	SW of Coal Oil Pt.	S	X	Tanker mooring floats
20.4(12.7)	Coast Guard float	SW of HOLLY	W	X	Radar reflector Radar reflector

PIERS AND PILINGS

13.3(8.2)	Recreation (Goleta Pier)	S of Goleta	W	X	
20.9(13.0)	Pier support	E of Ellwood Pier	C	X	
22.4(13.9)	Oil support (Ellwood Pier)	S of Ellwood	W	X	Abandoned

PLATFORMS

20.2(12.5)	Oil platform (HOLLY)	Off Coal Oil Pt.	S	X	
------------	----------------------	------------------	---	---	--

SURFACE SLICKS

6.9(4.3)	Oil	Off Hope Ranch		X	Natural seep
14.3(8.8)	Oil	Off Goleta Pier		X	Natural seep
20.9(13.0)	Oil	Off Coal Oil Pt.		X	Natural seep
21.1(13.1)	Oil alcohol	SW of HOLLY		X	Small artificial slick

VESSELS

15.6(9.7)	Sailboat (unid.)	SE of Coal Oil Pt.	F or W	X	Underway
19.9(12.3)	Cutter (PT. JUDITH)	SE of HOLLY	S	X	Anchored
21.1(13.1)	Oil crewboat (JUNE TIDE)	NW of HOLLY	S	X	Underway
22.1(13.7)	Oil crewboat (MALLARD)	E of Ellwood Pier	A	X	Anchored
22.1(13.7)	Ocean tug (CONTENDER)	E of Ellwood Pier	W	X	Anchored
24.8(15.4)	Cabin cruiser (unid.)	Off Naples Reef	F or W	X	Anchored

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 4, 0-25 km (Aircraft Heading 269°)

BUOYS, FLOATS, AND MOORINGS

23.4(14.5)	5-point mooring	Off Coal Oil Pt.	S	X	
23.5(14.6)	Marker buoy	SW of Coal Oil Pt.	S	X	Tanker mooring floats
24.1(14.9)	Live bait float	Off Goleta Pier	S+W	X	Radar reflector

PIERS AND PILINGS

24.3(15.1)	Recreation (Goleta Pier)	S of Goleta	W	X	
------------	--------------------------	-------------	---	---	--

PLATFORMS

21.1(13.1)	Oil drilling (HOLLY)	Off Coal Oil Pt.	S	X	
------------	----------------------	------------------	---	---	--

SURFACE SLICKS

20.4(12.7)	Oil	Off Goleta Pier		X	Natural seep
20.9(13.0)	Oil alcohol	SW of HOLLY		X	Small artificial slick
23.0(14.3)	Oil	Off Coal Oil Pt.		X	Natural seep

VESSELS

20.4(12.7)	Cutter (PT. JUDITH)	S of HOLLY	S	X	Anchored
20.7(12.8)	Ocean tug (unid.)	SE OF Capitan	W	X	Underway
21.6(13.4)	Oil crewboat (JUNE TIDE)	NW of HOLLY	S	X	Underway
24.0(14.9)	Sailboat (unid.)	Off Coal Oil Pt.	F or W	X	Underway

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 5, 0-25 km (Aircraft Heading 351°)

BUOYS, FLOATS, AND MOORINGS

8.7(5.4)	5-point mooring	Off Capitan	S	X	Tanker mooring floats
21.9(13.6)	Marker buoy	SW of Coal Oil Pt.	S	X	Radar reflector
22.4(13.9)	5-point mooring	Off Coal Oil Pt.	S	X	Tanker mooring floats

PIERS AND PILINGS

18.9(11.7)	Oil support (Eillwood Pier)	S of Eillwood	W	X	
20.4(12.7)	Pier support	E of Eillwood Pier	C	X	Abandoned

PLATFORMS

20.8(12.9)	Oil drilling (HOLLY)	Off Coal Oil Pt.	S	X	
------------	----------------------	------------------	---	---	--

SURFACE SLICKS

19.8(12.3)	Oil alcohol	SW of HOLLY			
19.9(12.3)	Oil	Off Coal Oil Pt.		X	Small artificial slick
				X	Natural seep

VESSELS

15.9(9.8)	Cabin cruiser (unid.)	Off Naples Reef	F or W	X	Anchored
19.4(12.0)	Oil crewboat (MALLARD)	E of Eillwood Pier	A	X	Anchored near CONTENDER
19.4(12.0)	Ocean tug (CONTENDER)	E of Eillwood Pier	W	X	Anchored
20.7(12.8)	Sailboat (unid.)	S of HOLLY	F or W	X	Underway
22.9(14.2)	Cutter (PT. JUDITH)	SW of HOLLY	S	X	Underway

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 6, 0-25 km (Aircraft Heading 093°)

BUOYS, FLOATS, AND MOORINGS

12.8(7.9)	Live bait float	Off Goleta Pier	S+W	X	
12.8(7.9)	Marker buoy	SW of Coal Oil Pt.	S	X	Radar reflector
13.0(8.1)	5-point mooring	Off Coal Oil Pt.	S	X	Tanker mooring floats

PIERS AND PILINGS

10.3(6.4)	Oil support (Ellwood Pier)	S of Ellwood	W	X	
11.1(6.9)	Pier support	E of Ellwood Pier	C	X	Abandoned
12.4(7.7)	Recreation (Goleta Pier)	S of Goleta	W	X	

PLATFORMS

14.9(9.2)	Oil drilling (HOLLY)	Off Coal Oil Pt.	S	X	
-----------	----------------------	------------------	---	---	--

SURFACE SLICKS

12.8(7.9)	Oil	Off Coal Oil Pt.		X	Natural seep
15.2(9.5)	Oil	Off Goleta Pier		X	Natural seep
15.4-17.9	Oil alcohol	SE of HOLLY		X	Long artificial slick
(9.6-11.0)					
15.5(9.6)	Oil alcohol	SW of HOLLY		X	Small artificial slick
15.6(9.7)	Oil	Off Hope Ranch		X	Natural seep

VESSELS

10.5(6.5)	Cabin cruiser (unid.)	Off Naples Reef	F or W	X	Anchored
10.6(6.6)	Oil crewboat (MALLARD)	E of Ellwood Pier	A	X	Anchored near CONTENDER
10.6(6.6)	Ocean tug (CONTENDER)	E of Ellwood Pier	W	X	Anchored
14.6(9.1)	Oil crewboat (JUNE TIDE)	NW of HOLLY	S	X	Underway
17.6(10.9)	Sailboat (unid.)	SW of Coal Oil Pt.	F or W	X	Underway
18.7(11.6)	Cutter (PT. JUDITH)	SE of HOLLY	S	X	Underway

B-21

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 7, 0-25 km (Aircraft Heading 178°)

BUOYS, FLOATS, AND MOORINGS

12.2(7.6)	Live bait float	S of Goleta Pier	S+W	X	
17.6(10.9)	5-point mooring	Off Coal Oil Pt.	S	X	Tanker mooring floats
18.2(11.3)	Marker buoy	SW of Coal Oil Pt.	S	X	Radar reflector

PIERS AND PILINGS

12.2(7.6)	Recreation (Goleta Pier)	S of Goleta	W	X	
19.8(12.3)	Pier support	E of Ellwood Pier	C	X	Abandoned
21.1(13.1)	Oil support (Ellwood Pier)	S of Ellwood	W	X	

PLATFORMS

19.3(12.0)	Oil drilling (HOLLY)	Off Coal Oil Pt.	S	X	
------------	----------------------	------------------	---	---	--

SURFACE SLICKS

6.0(3.7)	Oil	Off Hope Ranch		X	Natural seep
13.5(8.4)	Oil	Off Goleta Pier		X	Natural seep
16.0-18.7					
(10.0-11.6)	Oil alcohol	SE of HOLLY		X	Long artificial spill
19.4(12.0)	Oil	Off Coal Oil Pt.		X	Natural seep
20.2(12.5)	Oil alcohol	SW of HOLLY		X	Small artificial seep

VESSELS

14.5(9.0)	Cutter (PT. JUDITH)	SE of HOLLY	S	X	Underway
20.9(13.0)	Oil crewboat (MALLARD)	E of Ellwood Pier	A	X	Anchored near CONTENDER
20.9(13.0)	Ocean tug (CONTENDER)	E of Ellwood Pier	W	X	Anchored
22.1(13.7)	Sailboat (unid.)	SW of HOLLY	F or W	X	Underway
24.3(15.1)	Cabin cruiser (unid.)	Off Naples Reef	F or W	X	Anchored

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 8, 0-25 km (Aircraft Heading ~265°)

BUOYS, FLOATS, AND MOORINGS

20.2(12.5)	5-point mooring	Off Coal Oil Pt.	S	X	Tanker mooring floats
20.5(12.7)	Marker buoy	SW of Coal Oil Pt.	S	X	Radar reflector
21.8-22.9	Marker buoy/floats	SW of Capitan	S	X	For new Exxon platform;
(13.5-14.2)					3 buoys visible

PIERS AND PILINGS

22.4(13.9)	Pier support	E of Ellwood Pier	C	X	Abandoned
23.4(14.5)	Oil support (Ellwood Pier)	S of Ellwood	W	X	

PLATFORMS

18.6(11.5)	Oil drilling (HOLLY)	Off Coal Oil Pt.	S	X	
------------	----------------------	------------------	---	---	--

SURFACE SLICKS

15.0-18.9	Oil alcohol	SE of HOLLY		X	Long artificial slick
(9.3-11.7)					
18.2(11.3)	Oil alcohol	SW of HOLLY			
20.4(12.7)	Oil	Off Coal Oil Pt.		X	Small artificial slick
					Natural seep

VESSELS

17.0(10.5)	Sailboat (unid.)	SW of HOLLY	F or W	X	Underway
21.8(13.5)	Ocean tug (unid.)	SW of Capitan	W	X	Anchored
22.7(14.1)	Oil crewboat (JUNE TIDE)	NW of HOLLY	S	X	Underway
23.1(14.3)	Oil crewboat (MALLARD)	E of Ellwood Pier	A	X	Anchored near CONTENDER
23.1(14.3)	Ocean tug (CONTENDER)	E of Ellwood Pier	W	X	Anchored
23.6(14.6)	Cabin cruiser (unid.)	Off Naples Reef	F or W	X	Anchored

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 9, 0-50 Km (Aircraft Heading 360°)

BUOYS, FLOATS AND MOORINGS

23.7(14.7) Marker buoy	SW of Coal Oil Pt.	S	X		Radar reflector
25.0(15.5) 5-point mooring	Off Coal Oil Pt.	S	X		Tanker mooring floats
28.7(17.8) Live bait float	S of Goleta Pier	S&W		X	

PIERS AND PILINGS

19.6(12.2) Oil support (Elwood Pier)	S of Elwood	W	X		Abandoned
21.2(13.1) Pier support	E of Elwood Pier	C	X		
29.1(18.0) Recreation (Goleta Pier)	S of Goleta	W	X		
42.9(26.6) Recreation (Stearns Wharf)	Santa Barbara	W	X		
46.9(29.3) Private (Biltmore Pier)	SE of Santa Barbara	W	X		

PLATFORMS

21.7(13.4) Oil drilling (HOLLY)	Off Coal Oil Pt.	S	X		
43.7(27.1) Sewer pipelayings (SPIDER)	Off Santa Barbara	S	X		
50.0(31.0) Oil drilling (Union B)	Off Summerland	S	X		
50.8(31.5) Oil drilling (Union A)	Off Summerland	S	X		

SURFACE SLICKS

18.6(11.6) Oleyl alcohol	SW of Holly			X	Small artificial slick
19.0(11.9) Oil	Off Coal Oil Pt.			X	Natural seep
24.0(15.0) Oleyl alcohol	SE of Holly			X	Long artificial slick
28.0(17.5) Oil	Off Goleta Pier			X	Natural seep
35.1(21.9) Oil	Off Hope Ranch			X	Natural seep

Target ^A				
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No
Remarks				

VESSELS

15.5(9.7)	Sailboat (unid)	SW of Holly	F	X	Underway
19.9(12.3)	Oil crewboat (MALLARD)	E of Elwood Pier	A	X	Anchored near
19.9(12.3)	Ocean tug (CONTENDER)	E of Elwood Pier	W	X	Anchored
36.8(22.8)	Cutter (PT. JUDITH)	SW of Santa Barbara	S	X	Underway
43.7(27.1)	Sailing (PILOT)	Off Santa Barbara	W	X	Anchored
44.4(27.5)	Sand barge (unnamed)	Off Santa Barbara	S	X	Anchored inside kelp
44.4(27.5)	Sand barge (unnamed)	Off Santa Barbara	S	X	Anchored outside kelp

TABLE 2

DETECTION OF MARINA AND NEARSHORE TARGETS IN THE SANTA BARBARA CHANNEL
BY SYNTHETIC APERTURE (COR) RADAR, MAY 19, 1976

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 0, 0-25 km (Aircraft Heading 273°; Overwater Mode)

BUOYS, FLOATS, AND MOORINGS

9.4-11.0 (5.9-6.8)	Marker buoys and floats	SW of Capitan	S	X	Marking site for new Exxon platform; 6 of 8 buoys visible
10.4(6.4)	Coast Guard float	SW of Holly	W	X	Radar reflector
13.3(8.2)	5-point mooring	Off Coal Oil Pt.	S	X	Tanker mooring floats
13.5(8.4)	7-point mooring	Off Casitas Pier	S	X	Tanker mooring floats
13.6(8.4)	Marker buoy	SW of Coal Oil Pt.	S	X	Radar reflector
13.6(8.4)	Navigation buoy	Off Santa Barbara	S	X	Outer harbor buoy
14.1(8.7)	Navigation buoy	Off Santa Barbara	S	X	Inner harbor buoy
14.1(8.7)	Live bait float	S of Goleta Pier	S+W	X	
17.7(11.0)	5-point mooring	Off Capitan	S	X	Tanker mooring floats

PIERS AND PILINGS

14.0(8.7)	Oil support (Casitas Pier)	SE of Carpinteria	W	X	
14.9(9.2)	Recreation (Stearns Wharf)	Santa Barbara	W	X	
15.5(9.6)	Recreation (Goleta Pier)	S of Goleta	W	X	
15.6(9.7)	Private (Biltmore Pier)	E of Santa Barbara	W	X	
15.6(9.7)	Pier support	E of Ellwood Pier	C	X	Abandoned
15.6(9.7)	Oil support (Ellwood Pier)	S of Ellwood	W	X	

PLATFORMS

7.1(4.4)	Oil drilling (Union A)	Off Summerland	S	X	
7.1(4.4)	Oil drilling (Union B)	Off Summerland	S	X	
7.1(4.4)	Oil drilling (HILLHOUSE)	Off Summerland	S	X	
8.3(8.3)	Oil drilling (HOUGHIN)	Off Carpinteria	S	X	
8.8(5.4)	Oil drilling (HOGAN)	Off Carpinteria	S	X	
9.2(5.7)	Oil drilling (HOPE)	Off Carpinteria	S	X	
9.6(5.9)	Oil drilling (HEIDI)	Off Carpinteria	S	X	

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 0 (cont.)

11.3(7.0)	Oil drilling (HOLLY)	Off Coal Oil Pt.	S	X	
13.0(8.1)	Oil drilling (HILDA)	Off Summerland	S	X	
13.3(8.2)	Oil drilling (HAZEL)	Off Summerland	S	X	
15.1(9.4)	Sewer pipeelaying (SPIDER)	Off Santa Barbara	S	X	

SURFACE SLICKS

11.0(6.8)	Oil	Off Goleta Pier		X	Natural seep
11.0(6.8)	Oil	Off Coal Oil Pt.		X	Natural seep
11.6(7.2)	Oil	Off Hope Ranch		X	Natural seep
11.9(7.4)	Oil	Off Union A		X	Natural seep

VESSELS

7.1(4.4)	Oil crewboat (unid.)	N of HILLHOUSE	A or S	X	Underway
7.2(4.4)	Sailboat (unid.)	SW of Goleta Pier	F or W	X	Underway
8.4(5.2)	Ocean tug (unid.)	SW of HOLLY	W	X	Underway
10.4(6.4)	Oil crewboat (unid.)	N of HEIDI	A or S	X	Underway
10.6(6.6)	Cutter (PT. JUDITH)	SE of HOLLY	S	X	Anchored
13.3(8.2)	Crewboat (JUNE TIDE)	NW of HOLLY	S	X	Underway
14.3(8.8)	Cabin cruiser (unnamed)	Off Naples Reef	F or W	X	Anchored
14.5(8.9)	Sailboat (unid.)	S of Goleta Pier	F or W	X	Anchored
14.6(9.0)	Sand barge (unnamed)	Off Santa Barbara	S	X	Outside kelp bed
14.7(9.1)	Sand barge (unnamed)	Off Santa Barbara	S	X	Inside kelp bed
14.7(9.1)	Sailing vessel (PILOT)	Off Santa Barbara	W	X	Anchored
14.8(9.2)	Catamaran (unid.)	Off Santa Barbara	F or W	X	Anchored
14.8(9.2)	Sailboat (unid.)	Off Santa Barbara	F or W	X	Anchored
15.2(9.4)	Crewboat (MALLARD)	E of Ellwood Pier	A	X	Anchored near
15.2(9.4)	Ocean tug (CONTENDER)	E of Ellwood Pier	W	X	CONTENDER

Target ^A					
Range ^B km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 1, 0-25 km (Aircraft Heading 351°; Overwater Mode)

BUOYS, FLOATS, AND MOORINGS

14.9(9.2)	Coast Guard float	SW of HOLLY	W	X	Radar reflector
15.8(9.8)	Marker buoy	SW of Coal Oil Pt.	S	X	Radar reflector
17.9(11.1)	5-point mooring	Off Coal Oil Pt.	S	X	Tanker mooring floats

PIERS AND PILINGS

14.2(8.8)	Oil support (Ellwood Pier)	S of Ellwood	W	X	
15.6(9.7)	Pier support	E of Ellwood Pier	C	X	Abandoned
22.3(13.8)	Recreation (Goleta Pier)	S of Goleta	W	X	

PLATFORMS

15.6(9.7)	Oil drilling (HOLLY)	Off Coal Oil Pt.	S	X	
-----------	----------------------	------------------	---	---	--

SURFACE SLICKS

15.8(9.8)	Oil alcohol	SW of HOLLY			
16.5(10.2)	Oil	Off Coal Oil Pt.		X	Small artificial slick
23.0(14.3)	Oil	Off Goleta Point		X	Natural seep

VESSELS

14.4(8.9)	Oil crewboat (MALLARD)	E of Ellwood Pier	A	X	Anchored near CONTENDER
14.4(8.9)	Ocean tug (CONTENDER)	E of Ellwood Pier	W	X	Anchored
15.2(9.4)	Oil crewboat (JUNE TIDE)	NW of HOLLY	S	X	Underway
15.6(9.7)	Cutter (PT. JUDITH)	SE of HOLLY	S	X	Anchored
18.4(11.4)	Sailboat (unid.)	SW of Goleta Pier	F or W	X	Underway

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 2, 0-25 km (Aircraft Heading 093°; Overwater Mode)

BUOYS, FLOATS, AND MOORINGS

11.9(7.4)	Live bait float	S of Goleta Pier	S+W	X	
12.3(7.6)	Marker buoy	SW of Coal Oil Pt.	S		Radar reflector
12.6(7.8)	5-point mooring	Off Coal Oil Pt.	S	X	Tanker mooring floats
15.1(9.4)	Coast Guard float	SW of HOLLY	W	X	Radar reflector

PIERS AND PILINGS

10.3(6.4)	Oil support (Ellwood Pier)	S of Ellwood	W	X	
10.7(6.6)	Pier support	E of Ellwood Pier	C	X	Abandoned
11.3(7.0)	Recreation (Goleta Pier)	S of Goleta	W	X	

PLATFORMS

14.4(8.9)	Oil drilling (HOLLY)	Off Coal Oil Pt.	S	X	
-----------	----------------------	------------------	---	---	--

SURFACE SLICKS

13.3(8.2)	Oil	Off Coal Oil Pt.		X	Natural seep
14.4(8.9)	Oil	Off Hope Ranch		X	Natural seep
15.0(9.3)	Oil alcohol	SW of HOLLY			Small artificial slick
15.1(9.4)	Oil	Off Goleta Pier		X	Natural seep

VESSELS

10.3(6.4)	Oil crewboat (MALLARD)	E of Ellwood Pier	A	X	Anchored near CONTENDER
10.3(6.4)	Ocean tug (CONTENDER)	E of Ellwood Pier	W	X	Anchored
11.0(6.8)	Cabin cruiser (unid.)	Off Naples Reef	F or W	X	Anchored
14.9(9.2)	Cutter (PT. JUDITH)	SE of HOLLY	S	X	Anchored
16.3(10.1)	Ocean tug (unid.)	SW of HOLLY	W	X	Underway
18.0(11.2)	Sailboat (unid.)	SE of Coal Oil Pt.	F or W	X	Underway

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 3, 0-25 km (Aircraft Heading 185°; Land Mode)

BUOYS, FLOATS, AND MOORINGS

11.5(7.1)	Live bait float	S of Goleta Pier	S+W	X	
16.5(10.2)	5-point mooring	Off Coal Oil Pt.	S	X	Tanker mooring floats
17.4(10.8)	Marker buoy	SW of Coal Oil Pt.	S	X	Radar reflector
18.6(11.5)	Coast Guard float	SW of HOLLY	W	X	Radar reflector

PIERS AND PILINGS

11.5(7.1)	Recreation (Goleta Pier)	S of Goleta	W	X	
19.0(11.8)	Pier support	E of Ellwood Pier	C	X	Abandoned
20.2(12.5)	Oil support (Ellwood Pier)	S of Ellwood	W	X	

PLATFORMS

18.8(11.7)	Oil drilling (HOLLY)	Off Coal Oil Pt.	S	X	
------------	----------------------	------------------	---	---	--

SURFACE SLICKS

5.6(3.5)	Oil	Off Hope Ranch		X	Natural seep
12.5(7.7)	Oil	Off Goleta Pier		X	Natural seep
18.4(11.4)	Oil	Off Coal Oil Pt.		X	Natural seep
19.3(12.0)	Oil alcohol	SW of HOLLY		X	Small artificial slick

VESSELS

14.0(8.6)	Sailboat (unid.)	SE of Coal Oil Pt.	F or W	X	Underway
18.1(11.2)	Cutter (PT. JUDITH)	SE of HOLLY	S	X	Anchored
19.3(12.0)	Oil crewboat (JUNE TIDE)	NW of HOLLY	S	X	Underway
20.0(12.4)	Oil crewboat (MALLARD)	E of Ellwood Pier	A	X	Anchored near CONTENDER
20.0(12.4)	Ocean tug (CONTENDER)	E of Ellwood Pier	W	X	Anchored
22.7(14.1)	Cabin cruiser (unid.)	Off Naples Reef	F or W	X	Anchored

Target A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 4, 0-25 km (Aircraft Heading 269°; Land Mode)

BUOYS, FLOATS, AND MOORINGS

20.5(12.7)	Marker buoy	SW of Coal Oil Pt.	S	X	Radar reflector
20.5(12.7)	5-point mooring	Off Coal Oil Pt.	S	X	Tanker mooring floats
21.1(13.1)	Live bait float	S of Goleta Pier	S+W	X	

PIERS AND PILINGS

21.4(13.3)	Recreation (Goleta Pier)	S of Goleta	W	X	
22.1(13.7)	Pier support	E of Ellwood Pier	C	X	Abandoned
22.8(14.1)	Oil support (Ellwood Pier)	S of Ellwood	W	X	

PLATFORMS

18.6(11.5)	Oil drilling (HOLLY)	Off Coal Oil Pt.	S	X	
------------	----------------------	------------------	---	---	--

SURFACE SLICKS

18.1(11.2)	Oil alcohol	SW of HOLLY		X	Small artificial slick
19.5(12.1)	Oil	Off Goleta Pier		X	Natural seep
20.0(12.4)	Oil	Off Coal Oil Pt.		X	Natural seep

VESSELS

15.1(9.4)	Sailboat (unid.)	S of Coal Oil Pt.	F or W	X	Underway
17.8(11.0)	Cutter (PT. JUDITH)	S of HOLLY	S	X	Anchored
18.1(11.2)	Ocean tug (unid.)	SE of Capitán	W	X	Underway
19.0(11.8)	Oil crewboat (JUNE TIDE)	NW of HOLLY	S	X	Underway
22.5(13.9)	Oil crewboat (MALLARD)	E of Ellwood Pier	A	X	Anchored near CONTENDER
22.5(13.9)	Ocean tug (CONTENDER)	E of Ellwood Pier	W	X	Anchored
22.5(13.9)	Cabin cruiser (unid.)	Off Naples Reef	F or W	X	Anchored

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 5, 0-25 km (Aircraft Heading 351°; Overwater Mode)

BUOYS, FLOATS, AND MOORINGS

6.5(4.1)	5-point mooring	Off Capitan	S	X	Tanker mooring floats
18.9(11.7)	Marker buoy	SW of Coal Oil Pt.	S	X	Radar reflector
19.4(12.0)	5-point mooring	Off Coal Oil Pt.	S	X	Tanker mooring floats

PIERS AND PILINGS

16.3(10.1)	Oil support (Ellwood Pier)	S of Ellwood	W	X	
17.6(10.9)	Pier support	E of Ellwood Pier	C	X	Abandoned
24.6(15.3)	Recreation (Goleta Pier)	S of Goleta	W	X	

PLATFORMS

17.9(11.1)	Oil drilling (HOLLY)	Off Coal Oil Pt.	S	X	
------------	----------------------	------------------	---	---	--

SURFACE SLICKS

17.0(10.5)	Oil alcohol	SW of HOLLY			X Small artificial slick
17.7(11.0)	Oil	Off Coal Oil Pt.		X	Natural seep
23.5(14.5)	Oil	Off Goleta Pier		X	Natural seep

VESSELS

14.3(9.0)	Cabin cruiser (unid.)	Off Naples Reef	F or W	X	Anchored
16.4(10.2)	Oil crewboat (MALLARD)	E of Ellwood Pier	A	X	Anchored near CONTENDER
16.4(10.2)	Ocean tug (CONTENDER)	E of Ellwood Pier	W	X	Anchored
18.0(11.2)	Sailboat (unid.)	S of HOLLY	F or W	X	Underway
19.9(12.3)	Cutter (PT. JUDITH)	SW of HOLLY	S	X	Underway

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 6, 0-25 km (Aircraft Heading 093°; Overwater Mode)

BUOYS, FLOATS, AND MOORINGS

11.2(7.0)	Live bait float	Off Goleta Pier	S+W	X	
11.2(7.0)	Marker buoy	SW of Coal Oil Pt.	S	X	Radar reflector
11.4(7.1)	5-point mooring	Off Coal Oil Pt.	S	X	Tanker mooring floats

PIERS AND PILINGS

8.6(5.4)	Oil support (Ellwood Pier)	S of Ellwood	W	X	
9.3(5.8)	Pier support	E of Ellwood Pier	C	X	Abandoned
10.7(6.6)	Recreation (Goleta Pier)	S of Goleta	W	X	

PLATFORMS

13.0(8.1)	Oil drilling (HOLLY)	Off Coal Oil Pt.	S	X	
-----------	----------------------	------------------	---	---	--

SURFACE SLICKS

11.5(7.1)	Oil	Off Coal Oil Pt.		X	Natural seep
13.7-15.8 (8.5-9.8)	Oil alcohol	SE of HOLLY		X	Long artificial slick
14.1(8.7)	Oil alcohol	SW of HOLLY		X	Small artificial slick
14.2(8.8)	Oil	Off Goleta Pier		X	Natural seep
15.1(9.4)	Oil	Off Hope Ranch		X	Natural seep

VESSELS

9.0(5.5)	Cabin cruiser (unid.)	Off Naples Reef	F or W	X	Anchored
9.1(5.6)	Oil crewboat (MALLARD)	E of Ellwood Pier	A	X	Anchored near CONTENDER
9.1(5.6)	Ocean tug (CONTENDER)	E of Ellwood Pier	W	X	Anchored
12.9(8.0)	Oil crewboat (JUNE TIDE)	NW of HOLLY	S	X	Underway
15.6(9.7)	Sailboat (unid.)	SW of Coal Oil Pt.	F or W	X	Underway
16.5(10.2)	Cutter (PT. JUDITH)	SE of HOLLY	S	X	Underway

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 7, 0-25 km (Aircraft Heading 178°; Land Mode)

BUOYS, FLOATS, AND MOORINGS

10.7(6.6)	Live bait float	S of Goleta Pier	S+W	X	
15.7(9.8)	5-point mooring	Off Coal Oil Pt.	S	X	Tanker mooring floats
16.3(10.1)	Marker buoy	SW of Coal Oil Pt.	S	X	Radar reflector

PIERS AND PILINGS

10.7(6.6)	Recreation (Goleta Pier)	S of Goleta	W	X	
17.9(11.1)	Pier support	E of Ellwood Pier	C	X	Abandoned
19.1(11.8)	Oil support (Ellwood Pier)	S of Ellwood	W	X	

PLATFORMS

17.4(10.8)	Oil drilling (HOLLY)	Off Coal Oil Pt.	S	X	
------------	----------------------	------------------	---	---	--

SURFACE SLICKS

4.7(2.9)	Oil	Off Hope Ranch		X	Natural seep
12.2(7.6)	Oil	Off Goleta Pier		X	Natural seep
14.0-16.7	Oil alcohol	SE of HOLLY		X	Long artificial slick
8.6-10.4					
17.7(11.0)	Oil	Off Coal Oil Pt.		X	Natural seep
18.1(11.2)	Oil alcohol	SW of HOLLY		X	Small artificial slick

VESSELS

13.0(8.1)	Cutter (PT. JUDITH)	SE of HOLLY	S	X	Underway
18.9(11.7)	Oil crewboat (MALLARD)	E of Ellwood Pier	A	X	Anchored near CONTENDER
18.9(11.7)	Ocean tug (CONTENDER)	E of Ellwood Pier	W	X	Anchored
20.0(12.4)	Sailboat (unid.)	SW of HOLLY	F or W	X	Underway
21.4(13.2)	Cabin cruiser (unid.)	Off Naples Reef	F or W	X	Anchored

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 8, 0-25 km (Aircraft Heading $\approx 265^\circ$; Land Mode)

BUOYS, FLOATS, AND MOORINGS

17.7(11.0)	5-point mooring	Off Coal Oil Pt.	S	X	Tanker mooring floats
17.9(11.1)	Marker buoy	SW of Coal Oil Pt.	S	X	Radar reflector
19.5-20.5	Marker buoys and floats	SW of Capitan	S	X	Positioning buoys and floats
(12.1-12.7)					for new EXXON drilling platform;
					4 of 8 visible

PIERS AND PILINGS

20.0(12.4)	Pier support	E of Ellwood Pier	C	X	Abandoned
20.7(12.8)	Oil support (Ellwood Pier)	S of Ellwood	W	X	

PLATFORMS

16.2(10.0)	Oil drilling (HOLLY)	Off Coal Oil Pt.	S	X	
------------	----------------------	------------------	---	---	--

SURFACE SLICKS

13.0-15.6	Oil alcohol	SE of HOLLY		X	Long artificial slick
(3.1-9.7)					
16.2(10.0)	Oil alcohol	SW of HOLLY		X	Small artificial slick
17.9(11.1)	Oil	Off Coal Oil Pt.		X	Natural seep

VESSELS

14.9(9.2)	Sailboat (unid.)	SW of HOLLY	F or W	X	Underway
19.5(12.1)	Ocean tug (unid.)	SW of Capitan	W	X	Anchored
20.3(12.6)	Oil crewboat (JUNE TIDE)	NW of HOLLY	S	X	Underway
20.5(12.7)	Oil crewboat (MALLARD)	E of Ellwood Pier	A	X	Anchored near CONTENDER
20.5(12.7)	Ocean tug (CONTENDER)	E of Ellwood Pier	W	X	Anchored
20.5(12.7)	Cabin cruiser (unid.)	Off Naples Reef	F or W	X	Anchored

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 9, 20-45 km (Aircraft Heading 360°; Land Mode)

BUOYS, FLOATS, AND MOORINGS

21.8(13.5)	Marker buoy	SW of Coal Oil Pt.	S	X	Radar reflector
22.0(13.6)	5-point mooring	Off Coal Oil Pt.	S	X	Tanker mooring floats
27.1(16.8)	Live bait float	S of Goleta Pier	S+W	X	

PIERS AND PILINGS

27.1(16.8)	Recreation (Goleta Pier)	S of Goleta	W	X	
40.2(24.9)	Recreation (Stearns Wharf)	Santa Barbara	W	X	
44.1(27.3)	Private (Biltmore Pier)	SE of Santa Barbara	W	X	

PLATFORMS

40.6(25.1)	Sewer pipelaying (SPIDER)	Off Santa Barbara	S	X	
------------	---------------------------	-------------------	---	---	--

SURFACE SLICKS

20.8(12.9)	Oil	Off Coal Oil Pt.		X	Natural seep
22.8-25.1	Oil alcohol	SE of HOLLY		X	Long artificial slick
(14.2-15.6)					
26.1(16.2)	Oil	Off Goleta Pier		X	Natural seep
34.0(21.1)	Oil	Off Hope Ranch		X	Natural seep

VESSELS

33.0(20.5)	Cutter (PT. JUDITH)	SW of Santa Barbara	S	X	Underway
40.8(25.3)	Sailing vessel (PILOT)	Off Santa Barbara	W	X	Anchored
41.2(25.6)	Sand barge (unnamed)	Off Santa Barbara	S	X	Anchored outside kelp

TABLE 3
DETECTION OF MARINE AND NEARSHORE TARGETS IN THE OXNARD-PORT HUENEME-VENTURA AREA BY REAL APERTURE
(APS-94D) RADAR, MAY 20, 1976

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks
RUN 0, 0-25Km (Aircraft Heading \approx 230°)					
BUOYS, FLOATS AND MOORINGS					
5.8(3.6)	Navigation buoy	SE of Ventura Marina	S	X	Buoy #3/radar reflector
6.5(4.0)	5-point mooring	Off Ventura Marina	S	X	Tanker mooring
6.8(4.2)	Navigation buoy	Off Ventura Marina	S	X	Buoy #2/radar reflector
8.0(5.0)	9-point mooring	W of Ventura	S	X	Surrounding CUSS I
8.8(5.4)	5-point mooring	Off Ventura Pier	S	X	Tanker mooring
8.9(5.5)	Marker buoy	Off Ventura Pier	S	X	Buoy #1
PIERS, ROCK GROINS, AND BREAKWATERS					
6.3(3.9)	Breakwater	Off Ventura Marina	R	X	Parallel across marina entrance
9.8(6.1)	Recreation (Ventura Pier)	Ventura	W	X	
VESSELS					
8.0(5.0)	Oil drilling (CUSS I)	W of Ventura	S	X	Anchored
8.0(5.0)	Oil workboat (CALDWELL)	W of Ventura	S	X	Alongside CUSS I
RUN 1, 10-35Km (Aircraft Heading \approx 30°)					
BUOYS, FLOATS, AND MOORINGS					
13.7(8.5)	Coast Guard float	Off Channel Island Harbor	W	X	Radar reflector
14.2(8.8)	Marker buoy	SE of Channel Island Harbor	S	X	Buoy #5
16.7(10.3)	Navigation buoy	Off Hueneme Harbor	S	X	Buoy #6/radar reflector
21.0(13.0)	Marker buoy	Off Ormond Beach	S	X	Buoy #7

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

PIERS, ROCK GROINS, AND BREAKWATERS

13.8(8.6)	Breakwater	Off Channel Island Harbor	R	X	Parallel to entrance
16.7(10.3)	Rock groin	Hueneme Harbor	R	X	
18.2(11.3)	Recreation (Hueneme Pier)	SE of Hueneme Harbor	W	X	
22.6(14.0)	Government (Corps Pier)	SE of Hueneme Harbor	W	X	

VESSELS

11.4(7.1)	Cabin cruiser (unid)	SW of Channel Island Harbor	F or W	X	Underway
12.9(8.0)	Cutter (USCG)	Off Channel Island Harbor	A	X	Anchored
14.0(8.7)	Utility craft (LARC)	Inside Channel Island Harbor	A	X	Underway
14.7(9.1)	Cabin cruiser (unid)	E of Channel Island Harbor	F or W	X	Underway
14.7(9.1)	Cabin cruiser (unid)	SE of Channel Island Harbor	F or W	X	Underway
15.4(9.4)	Fishing boat (ESTRELLA)	SE of Channel Island Harbor	W	X	Underway
22.6(14.0)	Drone recovery (AVR)	Off Corps Pier	W	X	Anchored
23.7(14.7)	Fishing boat	SE of Corps Pier	W	X	Underway

RUN 2, 20-45Km (Aircraft Heading $\approx 30^\circ$)

BUOYS, FLOATS, AND MOORINGS

21.3(13.2)	Marker buoy	Off Mandalay Beach	S	X	Buoy #4
22.1(13.7)	7-point mooring	Off Mandalay Beach	S	X	Tanker mooring
26.7(16.6)	Coast Guard float	Off Channel Island Harbor	W	X	Radar reflector
27.8(17.2)	Marker buoy	SE of Channel Island Harbor	S	X	Buoy #5
29.8(18.5)	Navigation buoy	Off Hueneme Harbor	S	X	Buoy #6/radar reflector
33.8(21.0)	Marker buoy	Off Ormond Beach	S	X	Buoy #7

AD-A036 245

CALIFORNIA UNIV SANTA BARBARA GEOGRAPHY REMOTE SENSITIVE--ETC F/G 17/9
SUMMARY EVALUATION OF THE OFFSHORE TARGET DETECTION CAPABILITIES--ETC(U)
DEC 76 J E ESTES, S P KRAUS DOT-CG-63898-A

UNCLASSIFIED

USCG-D-125-76

NL

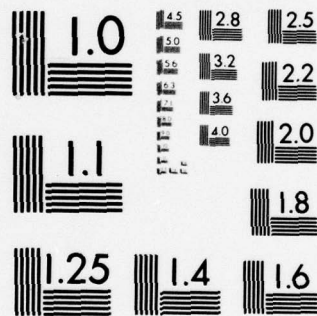
2 OF 2

AD
A036245



END

DATE
FILMED
3-77



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Target A					
Range B Km (mi)	Type C	Location D	Comp. E	Detected Yes No	Remarks

PIERS, ROCK GROINS, AND BREAKWATERS

26.8(16.7)	Breakwater	Off Channel Island Harbor	R	X	Parallel to harbor entrance
29.8(18.5)	Rock groin	Hueneme Harbor	R	X	
31.3(21.9)	Recreation (Hueneme Pier)	SE of Hueneme Harbor	W	X	
35.3(21.9)	Government (Corps Pier)	SE of Hueneme Harbor	W	X	

VESSELS

26.7(16.6)	Cutter (USCG)	Off Channel Island Harbor	A	X	Anchored Underway Underway Anchored
27.8(17.2)	Fishing boat (ESTRELLA)	SE of Channel Island Harbor	W	X	
28.2(17.5)	Sailboat (unid)	SE of Channel Island Harbor	F or W	X	
34.0(21.1)	Fishing boat (unid)	Off Ormond Beach	W	X	
35.3(21.9)	Drone recovery (AVR)	Off Corps Pier	W	X	

RUN 3, 20-45Km (Aircraft Heading $\approx 30^\circ$)

BUOYS, FLOATS, AND MOORINGS

30.6(19.0)	9-point mooring	W of Ventura	S	X	Surrounding CUSS I Buoy #1 Tanker mooring Buoy #2/radar reflector Tanker mooring Buoy #3/radar reflector Buoy #4 Tanker mooring
32.6(20.2)	Marker buoy	Off Ventura Pier	S	X	
32.9(20.4)	5-point mooring	Off Ventura Pier	S	X	
34.8(21.6)	Navigation buoy	Off Ventura Marina	S	X	
35.3(21.9)	5-point mooring	Off Ventura Marina	S	X	
35.9(22.3)	Navigation buoy	SE of Ventura Marina	S	X	
39.7(24.6)	Marker buoy	Off Mandalay Beach	S	X	
40.2(24.9)	7-point mooring	Off Mandalay Beach	S	X	

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

PIERS, ROCK GROINS, AND BREAKWATERS

32.3(20.0)	Recreation (Ventura Pier)	Ventura	W	X	
35.8(22.2)	Breakwater	Off Ventura Marina	R	X	Parallel to Marina entrance

VESSELS

30.6(19.0)	Oil drilling (CUSS I)	W of Ventura	S	X	Anchored
30.6(19.0)	Oil workboat (CALDWELL)	W of Ventura	S	X	Alongside CUSS I

RUN 3A, 30-55Km (Aircraft Heading $\approx 30^\circ$)

BUOYS, FLOATS AND MOORINGS

35.0(21.7)	9-point mooring	W of Ventura	S	X	Surrounding CUSS I
27.9(23.5)	Marker buoy	Off Ventura Pier	S	X	Buoy #1
38.6(24.0)	5-point mooring	Off Ventura Pier	S	X	Tanker mooring
40.1(24.9)	Navigation buoy	Off Ventura Marina	S	X	Buoy #2/radar reflector
40.8(25.3)	5-point mooring	Off Ventura Marina	S	X	Tanker mooring
41.1(25.5)	Navigation buoy	SE of Ventura Marina	S	X	Buoy #3/radar reflector
43.3(26.8)	Marker buoy	Off Mandalay Beach	S	X	Buoy #4
45.2(28.1)	7-point mooring	Off Mandalay Beach	S	X	Tanker mooring
53.3(33.1)	Marker buoy	SE of Channel Island Harbor	S	X	Buoy #5

VESSELS

35.0(21.7)	Oil drilling (CUSS I)	W of Ventura	S	X	Anchored
35.0(21.7)	Oil workboat (CALDWELL)	W of Ventura	S	X	Alongside CUSS I
52.7(32.7)	Oil crewboat (WARM TIDE)	Off Hueneme Harbor	A	X	Underway
54.9(34.0)	Fishing boat (untd)	SW of Hueneme Pier	W	X	Underway

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 4, 40-65Km (Aircraft Heading 30°)

BUOYS, FLOATS, AND MOORINGS

42.7(26.5)	9-point mooring	W of Ventura	S	X	Surrounding CUSS I
45.4(28.2)	Marker buoy	Off Ventura Pier	S	X	Buoy #1
45.7(28.3)	5-point mooring	Off Ventura Pier	S	X	Tanker mooring
47.6(29.5)	Navigation buoy	Off Ventura Marina	S	X	Buoy #2/radar reflector
48.1(29.8)	5-point mooring	Off Ventura Marina	S	X	Tanker mooring
48.6(30.1)	Navigation	SW of Ventura Marina	S	X	Buoy #3/radar reflector
52.3(32.4)	Marker buoy	Off Mandalay Beach	S	X	Buoy #4
52.8(32.7)	7-point mooring	Off Mandalay Beach	S	X	Tanker mooring
58.7(36.4)	Marker buoy	SE of Channel Island Harbor	S	X	Buoy #5
61.1(37.9)	Navigation buoy	Off Hueneme Harbor	S	X	Buoy #6/radar reflector

PIERS, ROCK GROINS AND BREAKWATERS

48.4(30.0)	Breakwater	Off Ventura Marina	R	X	Parallel to harbor entrance
58.4(36.2)	Breakwater	Off Channel Island Harbor	R	X	Parallel to harbor entrance
60.6(37.6)	Rock groin	Hueneme Harbor	R	X	
62.3(38.6)	Recreation (Hueneme Pier)	SE of Hueneme Harbor	W	X	

VESSELS

42.7(26.5)	Oil drilling (CUSS I)	W of Ventura	S	X	Anchored
42.7(26.5)	Oil workboat (CALDWELL)	W of Ventura	S	X	Alongside CUSS I
56.9(35.3)	Oil crewboat (WARM TIDE)	SW of Channel Island Harbor	A	X	Underway
57.4(35.6)	Fishing boat (unid)	SE of Channel Island Harbor	W	X	Underway
58.1(36.0)	Sailboat (unid)	SE of Channel Island Harbor	F or W	X	Underway
58.2(36.1)	Fishing boat (unid)	SW of Channel Island Harbor	W	X	Underway

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 5, 50-75Km (Aircraft Heading $\approx 30^\circ$)

BUOYS, FLOATS, AND MOORINGS

56.2(34.8)	9-point mooring	W of Ventura	S	X	Surrounding CUSS I
60.1(37.3)	Marker buoy	Off Ventura Pier	S	X	Buoy #1
62.3(38.6)	Navigation buoy	Off Ventura Marina	S	X	Buoy #2/radar reflector
62.5(38.8)	Navigation buoy	SE of Ventura Marina	S	X	Buoy #3/radar reflector
70.0(41.5)	Marker buoy	Off Mandalay Beach	S	X	Buoy #4
70.0(41.5)	7-point mooring	Off Mandalay Beach	S	X	Tanker mooring
75.3(46.7)	Navigation	Off Hueneme Harbor	S	X	Buoy #6

PIERS, ROCK GROINS, AND BREAKWATERS

72.6(45.0)	Breakwater	Off Channel Island Harbor	R	X	Parallel to harbor entrance
74.8(46.4)	Rock groin	Hueneme Harbor	R	X	

VESSELS

56.2(34.8)	Oil drilling (CUSS I)	W of Ventura	S	X	Anchored
56.2(34.8)	Oil drilling (CALDWELL)	W of Ventura	S	X	Alongside CUSS I
69.1(42.9)	Cargo crewboat (WARM TIDE)	Off Ormond Beach	A	X	Underway
75.0(46.5)	Cargo (PRESIDENT TAFT)	NW of Channel Island Harbor	S	X	Underway

TABLE 4

DETECTION OF MARINE AND NEARSHORE TARGETS IN THE MORRO BAY AREA
BY SYNTHETIC APERTURE (COR) RADAR, MAY 21, 1976

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected ^F Yes No	Remarks

RUN 8, 0-25Km (Aircraft Heading $\approx 340^\circ$; Overwater Mode)

BUOYS

2.5(1.5)	Navigation	SW of Pt. Buchon	S	X	Buoy #2 (see Morro Bay ref map)
4.6(2.8)	Navigation	NW of Morro Rock	S	X	Buoy #10/radar reflector
6.3(3.9)	Marker	NW of Cayucos	S	X	Buoy #9
7.5(4.6)	Marker	S of Cayucos Pier	S	X	Buoy #8
8.1(5.0)	Marker	NW of Morro Rock	S	X	Buoy #4
8.4(5.2)	Marker	NW of Morro Rock	S	X	Buoy #5/radar reflector
8.6(5.4)	Navigation	S of Morro Rock	S	X	Buoy #3
8.7(5.4)	Marker	SW of Chevron Pier	S	X	Buoy #6
8.9(5.5)	Marker	NW of Chevron Pier	S	X	Buoy #7/radar reflector
13.7(8.5)	Navigation	SE of Pt. San Luis	S	X	Buoy #1

MOORINGS

9.0(5.6)	7-point mooring	NW of Chevron Pier	S	X	7-point #2
9.1(5.6)	5-point mooring	SW of Chevron Pier	S	X	5-point #3; 2 floats visible
9.1(5.6)	5-point mooring	Off Morro Beach	S	X	5-point #1; 5 floats visible
9.2(5.7)	7-point mooring	NW of Morro Rock	S	X	7-point #1; 3 floats visible
9.3(5.8)	5-point mooring	Off Morro Beach	S	X	5-point #2; 3 floats visible
14.9(9.2)	4-point mooring	San Luis Obispo Bay	S	X	2 floats visible

PIERS AND ROCK GROINS

7.9(4.9)	Recreation(Cayucos Pier)	Cayucos	W	X	
9.1(5.6)	Rock groin	Adjacent to Morro Rock	R	X	
9.2(5.7)	Rock groin	SE of Morro Rock	R	X	
9.7(6.0)	Oil support(Chevron Pier)	NW of Morro Beach	W	X	
13.3(8.4)	Recreation(Pt San Luis Pr)	Port San Luis	W	X	
13.5(8.4)	Rock groin	Off Pt. San Luis	R	X	
14.8(9.2)	Oil support pier	SW of Avila Beach	W	X	
15.5(9.6)	Recreation(Avila Pier)	Avila Beach	W	X	

Target ^A				
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No
Remarks				

RUN 8 (Cont.)

VESSELS

None identified due to delayed arrival of ground truth aircraft

RUN 9, 0-25Km (Aircraft Heading 009°; Overwater Mode)

BUOYS

12.8(7.9) Navigation	NW of Morro Rock	S	X	Buoy #10/radar reflector
13.5(8.4) Marker	NW of Cayucos	S	X	Buoy #9
14.8(9.2) Marker	S of Cayucos Pier	S	X	Buoy #8
16.5(10.2) Marker	NW of Chevron Pier	S	X	Buoy #7/radar reflector
17.0(10.5) Navigation	SW of Pt. Buchon	S	X	Buoy #2
17.3(10.7) Marker	NW of Morro Rock	S	X	Buoy #4
17.7(11.0) Marker	NW of Morro Rock	S	X	Buoy #5/radar reflector
18.7(11.6) Navigation	S of Morro Rock	S	X	Buoy #3
19.9(12.3) Marker	SW of Chevron Pier	S	X	Buoy #6

MOORINGS

17.2(10.7) 7-point mooring	NW of Morro Rock	S	X	7-point #1; 6 floats visible
17.6(10.9) 5-point mooring	SW of Chevron Pier	S	X	5-point #3; 4 floats visible
17.9(11.1) 5-point mooring	Off Morro Beach	S	X	5-point #2; 3 floats visible
18.0(11.2) 5-point mooring	Off Morro Beach	S	X	5-point #1; 5 floats visible
18.4(11.4) 7-point mooring	NW of Chevron Pier	S	X	7-point #2; 5 floats visible

PIERS AND ROCK GROINS

14.9(9.2) Recreation (Cayucos Pier)	Cayucos	W	X	
17.9(11.1) Oil support (Chevron Pier)	NW of Morro Beach	W	X	
18.8(11.7) Rock groin	SE of Morro Rock	R	X	
19.3(12.0) Rock groin	Adjacent to Morro Rock	R	X	

B-44

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 9 (Cont.)

VESSELS

13.4(8.3) Cutter (CAPE HEDGE) Off Morro Rock S X Anchored

RUN 10, 0-25km (Aircraft Heading 095°; Overwater Mode)

BUOYS

4.3(2.7) Marker	NW of Cayucos	S	X	Buoy #9
4.8(3.0) Marker	S of Cayucos Pier	S	X	Buoy #8
7.4(4.6) Marker	NW of Chevron Pier	S	X	Buoy #7/radar reflector
8.9(5.5) Navigation	NW of Morro Rock	S	X	Buoy #10/radar reflector
9.6(5.9) Marker	SW of Chevron Pier	S	X	Buoy #6
10.4(6.4) Marker	NW of Morro Rock	S	X	Buoy #4
10.5(6.5) Marker	NW of Morro Rock	S	X	Buoy #5/radar reflector
14.3(8.9) Navigation	S of Morro Rock	S	X	Buoy #3

MOORINGS

7.5(4.6) 7-point mooring	NW of Chevron Pier	S	X	7-point #2; 5 floats detected
8.2(5.1) 5-point mooring	Off Morro Beach	S	X	5-point #3; 4 floats detected
8.9(5.5) 5-point mooring	Off Morro Beach	S	X	5-point #2; 4 floats detected
9.6(5.9) 5-point mooring	SW of Chevron Pier	S	X	5-point #1
10.7(6.6) 7-point mooring	NW of Morro Rock	S	X	7-point #1

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 10 (Cont.)

PIERS AND ROCK GROINS

4.0(2.5)	Recreation (Cayucos Pier)	Cayucos	W	X	
7.6(4.7)	Oil support (Chevron Pier)	NW of Morro Beach	W	X	
12.2(7.5)	Rock groin	SW of Morro Rock	R	X	
12.8(7.9)	Rock groin	Adjacent to Morro Rock	R		X

VESSELS

14.2(8.8)	Cutter (CAPE HEDGE)	Off Morro Rock	S	X	Anchored
14.9(9.2)	Cabin cruiser (unid)	SW of Morro Rock	F or W	X	Anchored
14.9(9.2)	Fishing boat (unid)	SW of Morro Rock	W	X	Anchored
15.0(9.3)	Fishing boat (unid)	SW of Morro Rock	W	X	Anchored
15.1(9.4)	Cabin cruiser (unid)	SW of Morro Rock	F or W	X	Anchored

RUN 11, 0-25Km (Aircraft Heading 180°; Overwater Mode)

BUOYS

8.7(5.4)	Navigation	Morro Bay Channel	S	X	Buoy #15/radar reflector
9.2(5.7)	Navigation	Morro Bay Channel	S	X	Buoy #14/radar reflector
9.2(5.7)	Navigation	Morro Bay Channel	S	X	Buoy #16/radar reflector
9.3(5.8)	Navigation	Morro Bay Channel	S	X	Buoy #13/radar reflector
9.6(6.0)	Navigation	Morro Bay Channel	S	X	Buoy #12/radar reflector
9.7(6.0)	Navigation	Morro Bay Channel	S	X	Buoy #11/radar reflector
10.0(6.2)	Navigation	S of Morro Rock	S	X	Buoy #3
10.9(6.8)	Marker	NW of Morro Rock	S	X	Buoy #5/radar reflector
11.1(6.9)	Marker	SW of Chevron Pier	S		Buoy #6
11.4(7.1)	Marker	NW of Morro Rock	S	X	Buoy #4
12.0(7.4)	Marker	NW of Chevron Pier	S	X	Buoy #7/radar reflector

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks
12.1(7.5)	Navigation	SW of Pt. Buchon	S	X	Buoy #2
13.7(8.5)	Marker	S of Cayucos Pier	S	X	Buoy #8
15.1(9.4)	Marker	NW of Cayucos Pier	S	X	Buoy #9
15.5(9.6)	Navigation	NW of Morro Rock	S	X	Buoy #10/radar reflector
MOORINGS					
10.5(6.5)	7-point mooring	NW of Morro Rock	S	X	7-point #1
10.5(6.5)	5-point mooring	Off Morro Beach	S	X	5-point #1
10.6(6.6)	5-point mooring	Off Morro Beach	S	X	5-point #2
10.9(6.8)	5-point mooring	SW of Chevron Pier	S	X	5-point #3
11.4(7.1)	7-point mooring	NW of Chevron Pier	S	X	7-point #2
PIERS AND ROCK GROINS					
9.3(5.8)	Rock groin	SE of Morro Rock	R	X	
9.8(6.1)	Rock groin	Adjacent to Morro Rock	R	X	
10.6(6.6)	Oil Support (Chevron Pier)	NW of Morro Beach	W	X	
15.5(9.6)	Recreation (Cayucos Pier)	Cayucos	W	X	
VESSELS					
19.9(12.3)	Cutter (CAPE HEDGE)	Off Morro Rock		X	Anchored

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 12, 0-25Km (Aircraft Heading 271°; Overland Mode)

BUOYS

2.8(1.8)	Navigation	SW of Pt. Buchon	S	X	Buoy #2
15.6(9.7)	Navigation	S of Morro Rock	S	X	Buoy #3
18.1(11.2)	Marker	NW of Morro Rock	S	X	Buoy #5/radar reflector
18.2(11.3)	Marker	NW of Morro Rock	S	X	Buoy #4
19.4(12.0)	Navigation	NW of Morro Rock	S	X	Buoy #10/radar reflector
21.3(13.2)	Marker	SW of Chevron Pier	S	X	Buoy #7
23.7(14.7)	Marker	S of Cayucos Pier	S	X	Buoy #8
24.2(15.0)	Marker	SW of Cayucos Pier	S	X	Buoy #9

MOORINGS

17.9(11.1)	7-point mooring	NW of Morro Rock	S	X	7-point #1
19.1(11.8)	5-point mooring	Off Morro Beach	S	X	5-point #1
19.8(12.2)	5-point mooring	Off Morro Beach	S	X	5-point #2
20.6(12.7)	5-point mooring	SW of Chevron Pier	S	X	5-point #3
21.1(13.1)	7-point mooring	NW of Chevron Pier	S	X	7-point #2

PIERS AND ROCK GROINS

15.9(9.9)	Rock groin	SE of Morro Rock	R	X	
16.3(10.1)	Rock groin	Adjacent to Morro Rock	R	X	
21.1(13.1)	Oil support (Chevron Pier)	NW of Morro Beach	W	X	
24.6(15.3)	Recreation (Cayucos Pier)	Cayucos	W	X	

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 12 (Cont.)

VESSELS

12.8(7.9)	Cabin cruiser (unid)	SW of Morro Rock	F or W	X	Anchored
13.0(8.1)	Fishing boat (unid)	SW of Morro Rock	W	X	Anchored
13.1(8.2)	Fishing boat (unid)	SW of Morro Rock	W	X	Anchored
13.2(8.3)	Cabin cruiser (unid)	SW of Morro Rock	F or W	X	Anchored
14.2(8.8)	Cutter (CAPE HEDGE)	Off Morro Rock	S	X	Anchored

RUN 13, 20-45Km (Aircraft Heading 050°; Overwater Mode)

Distorted Image - Not Analyzed

RUN 14, 0-25Km (Aircraft Heading 176°; Overwater Mode)

BUOYS

9.0(5.6)	Navigation	S of Morro Rock	S	X	Buoy #3
9.8(6.1)	Marker	NW of Morro Rock	S	X	Buoy #5/radar reflector
9.8(6.1)	Marker	SW of Chevron Pier	S	X	Buoy #6
10.1(6.3)	Marker	NW of Chevron Pier	S	X	Buoy #7/radar reflector
10.3(6.4)	Marker	NW of Morro Rock	S	X	Buoy #4
11.6(7.2)	Marker	S of Cayucos Pier	S	X	Buoy #8
12.3(7.6)	Navigation	SW of Pt. Buchon	S	X	Buoy #2
12.9(8.0)	Marker	NW of Cayucos	S	X	Buoy #9
14.2(8.8)	Navigation	NW of Morro Rock	S	X	Buoy #10/radar reflector

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 14 (Cont.)

MOORINGS

9.3(5.8)	7-point mooring	SW of Morro Rock	S	X	7-point #1
9.3(5.8)	5-point mooring	Off Morro Beach	S	X	5-point #2
9.4(5.9)	5-point mooring	Off Morro Beach	S	X	5-point #1
9.4(5.9)	5-point mooring	SW of Chevron Pier	S	X	5-point #3
9.9(6.1)	7-point mooring	NW of Chevron Pier	S	X	7-point #2

PIERS AND ROCK GROINS

8.4(5.2)	Rock groin	SE of Morro Rock	R	X	
8.7(5.4)	Rock groin	Adjacent to Morro Rock	R	X	
9.3(5.8)	Oil support (Chevron Pier)	NW of Morro Beach	W	X	
11.4(7.1)	Recreation (Cayucos Pier)	Cayucos	W	X	

VESSELS

9.7(6.0)	Cabin cruiser (unid)	Off Morro Rock	F or W	X	Anchored
9.8(6.1)	Fishing boat (unid)	Off Morro Rock	W	X	Anchored
18.5(11.4)	Fishing boat (unid)	SW of Morro Rock	W	X	Anchored
18.6(11.5)	Fishing boat (unid)	SW of Morro Rock	W	X	Anchored
18.8(11.6)	Cabin cruiser (unid)	SW of Morro Rock	F or W	X	Anchored
19.0(11.8)	Cabin cruiser (unid)	SW of Morro Rock	F or W	X	Anchored
20.3(12.6)	Cutter (CAPE HEDGE)	Off Morro Rock	S	X	Underway

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 15, 0-25Km (Aircraft Heading 274°; Overwater Mode)

BUOYS

3.1(1.9) Navigation	SW of Pt. Buchon	S	X	Buoy #2
15.8(9.8) Navigation	S of Morro Rock	S	X	Buoy #3
16.7(10.4) Marker	NW of Morro Rock	S	X	Buoy #4
16.7(10.4) Marker	NW of Morro Rock	S	X	Buoy #5/radar reflector
18.2(11.3) Marker	SW of Chevron Pier	S	X	Buoy #6
19.3(12.0) Navigation	NW of Morro Rock	S	X	Buoy #10/radar reflector
21.1(13.1) Marker	NW of Chevron Pier	S	X	Buoy #7/radar reflector
23.5(14.5) Marker	S of Cayucos	S	X	Buoy #8
23.8(14.8) Marker	NW of Cayucos	S	X	Buoy #9

MOORINGS

16.7(10.4) 7-point mooring	NW of Morro Rock	S	X	7-point #1
18.1(11.2) 5-point mooring	Off Morro Beach	S	X	5-point #1
18.8(11.7) 5-point mooring	Off Morro Beach	S	X	5-point #2
19.5(12.1) 5-point mooring	SW of Chevron Pier	S	X	5-point #3
20.1(12.5) 7-point mooring	NW of Chevron Pier	S	X	7-point #2

PIERS AND ROCK GROINS

16.2(10.0) Rock groin	SE of Morro Rock	R	X	
16.5(10.2) Rock groin	Adjacent to Morro Rock	R	X	
20.0(12.4) 011 Support (Chevron Pier)	NW of Morro Beach	W	X	
24.2(15.0) Recreation (Cayucos Pier)	Cayucos	W		X

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 15 (Cont.)

VESSELS

16.5(10.2)	Fishing boat (unid)	Off Morro Rock	W	X	Anchored
17.0(10.5)	Cabin cruiser (unid)	Off Morro Rock	F or W	X	Anchored
17.3(10.7)	Fishing boat (unid)	Off Morro Rock	W	X	Anchored

RUN 16, 0-25Km (Aircraft Heading 002°; Overwater Mode)

BUOYS

6.2(3.8)	Navigation	NW of Morro Rock	S	X	Buoy #10/radar reflector
6.9(4.3)	Marker	NW of Cayucos	S	X	Buoy #9
8.7(5.4)	Marker	S of Cayucos Pier	S	X	Buoy #8
9.3(5.8)	Marker	NW of Morro Rock	S	X	Buoy #5/radar reflector
9.8(6.1)	Marker	NW of Chevron Pier	S	X	Buoy #7/radar reflector
10.1(6.3)	Marker	NW of Morro Rock	S	X	Buoy #4
10.5(6.5)	Marker	SW of Chevron Pier	S	X	Buoy #6
11.4(7.1)	Navigation	S of Morro Rock	S	X	Buoy #3

MOORINGS

10.3(6.4)	7-point mooring	NW of Chevron Pier	S	X	7-point #2
10.6(6.6)	5-point mooring	SW of Chevron Pier	S	X	5-point #3
11.1(6.9)	5-point mooring	Off Morro Beach	S	X	5-point #2
11.1(6.9)	5-point mooring	Off Morro Beach	S	X	5-point #1
11.4(7.1)	7-point mooring	NW of Morro Rock	S	X	7-point #1

Target ^A					
Range ^B Km (mi)	Type ^C	Location ^D	Comp. ^E	Detected Yes No	Remarks

RUN 16 (Cont.)

PIERS AND ROCK GROINS

8.4(5.2)	Recreation (Cayucos Pier)	Cayucos	W	X	
11.2(6.9)	Oil support (Chevron Pier)	NW of Morro Beach	W	X	
11.6(7.2)	Rock groin	Adjacent to Morro Rock	R	X	
12.0(7.4)	Rock groin	SE of Morro Rock	R	X	

VESSELS

9.0(5.6)	Fishing boat (unid)	Off Morro Rock	W	X	Anchored
9.2(5.7)	Fishing boat (unid)	Off Morro Rock	W	X	Underway
11.2(6.9)	Cabin cruiser (unid)	SW of Morro Rock	F or W	X	Anchored

RUN 17

Not Analyzed

Footnotes for Appendix B

A - All known man-made and surface slick targets identified in image (run) area during ground truth data collection.
 B - Slant range distance from aircraft to target. Derived for each target using formula:

$$SK = \frac{H}{\sin \psi_2} - \frac{H}{\sin \psi_1} \cdot \frac{1}{x}$$

Where: SK = Slant range scale/unit value

H = Aircraft altitude

ψ_1 = Aspect angle at start of imaging run

ψ_2 = Aspect angle at end of imaging run

x = Measured width across the radar image

C = Type of target

D = Location of target (refer to area baseline maps - Figures 1A, 1B, 1C)

E = Material composition of target: A-aluminum; C-concrete; F-fiber glass; P-plastic; R-rock; S-steel; and W-wooden

APPENDIX C

Summary Evaluation of the Capabilities of APS-94D and COR Radars to Detect Selected Marine and Near- shore Targets Off Southcentral California (May 19-21, 1976)

- I. Santa Barbara Channel (APS-94D and COR)**
- II. Oxnard-Port Hueneme-Ventura Area (APS-94D only)**
- III. Morro Bay Area (COR only)**

EXPLANATORY NOTES

Data are presented in tabular form for the APS-94D and COR systems on a run-by-run, individual target basis (also see Appendix B, Tables 1-4). The basic methodology used by GRSU researchers in ranking the target detection capabilities of each system was to:

- * Analyze all useable APS-94D and COR radar imagery flown during the three day test program.
- * Locate and identify known marine and nearshore targets imaged by each system on a run-by-run basis.
- * Rank individual target returns qualitatively on a scale from poor to good (see below). Ranking primarily was based on the sharpness and target resolving characteristics of target returns. Known targets for which no radar return was recorded were classified as not detected.

Target Resolution Classification Key

- G - Good. Target sharp and well-defined. Where targets are clustered, individual targets or components of individual targets (e.g., floats within a tanker mooring) are clearly discernable.
- F - Fair. Target readily identifiable, but lacks sharpness and clarity. Individual targets often merge together or with image background.
- P - Poor. Target usually identifiable only through prior knowledge of exact location. Lacks sharpness and characteristically merges with background. Separate components of an individual target (e.g. floats in a tanker mooring) cannot be discriminated.
- ND - Not Detected. Target not recorded on the image.
- No Symbol - Not Imaged. Target not located within the area imaged.

Date: May 19, 1976
 Location: Santa Barbara Channel between Carpinteria and Capitan (see Figure 2)
 Systems: APS-94D and COR

APS-94D (Use with Table 1, Appendix B)

TARGET	LOCATION	Run (see Figure 1A)									
		0	1	2	3	4	5	6	7	8	9
<u>BUOYS, FLOATS AND MOORINGS</u>											
Positioning buoys/floats	SW of Capitan	G								G	
Coast Guard Float	SW of Holly	F	G	G	G						
7-point mooring	Off Casitas Pier	G									
5-point mooring	Off Coal Oil Point	G	G	G	G	G	F	G	G	G	F
5-point mooring	Off Capitan	G	G	G			G	G			
Marker buoy	SW of Coal Oil Point	G	G	G	G	G	G	G	G	G	G
Navigation buoy	Off Santa Barbara (inner)	G									
Navigation buoy	Off Santa Barbara (outer)		G								
Live bait float	Off Goleta Pier	G		G	G	G		F	G		P
<u>PIERS AND PILINGS</u>											
Casitas Pier	SE of Carpinteria	G									
Biltmore Pier	E of Santa Barbara	G									F
Stearns Wharf	Santa Barbara	G									P
Goleta Pier	S of Goleta	G		G	G	G		G	G		F
Elwood Pier	S of Elwood	G	G	G	G		G	G	G	G	G
Pier support	E of Elwood Pier	G	G	G	G		G	G	G	G	G
<u>PLATFORMS</u>											
Union A	Off Summerland	G									G
Union B	Off Summerland	G									G
Hillhouse	Off Summerland	G									
Hilda	Off Summerland	G									
Hazel	Off Summerland										
Houchin	Off Carpinteria	G									
Hogan	Off Carpinteria	G									
Hope	Off Carpinteria	G									
Heidi	Off Carpinteria	G									
Holly	Off Coal Oil Point	G	G	G	G	G	G	G	G	G	G
Spider	Off Santa Barbara	G									F
<u>SURFACE SLICKS</u>											
Oil	Union A to Santa Barbara	ND									
Oil	Off Hope Ranch	ND		F	G			ND	G		ND
Oil	Off Goleta Pier	ND	ND	G	G	ND		ND	G		ND
Oil	Off Coal Oil Point	ND	ND	ND	G	ND	ND	ND	G	P	ND
01ey1 alcohol	SW of Holly		ND	ND	ND	ND	ND	ND	ND	ND	ND
01ey1 alcohol	SE of Holly							ND	G	P	ND

TARGET	LOCATION	Run (see Figure 1A)									
		0	1	2	3	4	5	6	7	8	9
<u>VESSELS</u>											
Sailboat (unid)	SW of Goleta Pier- SW of Holly	G	G	G	G	G	G	G	G	G	G
Sailboat (unid)	Off Goleta Pier	G		G	G	G		G			
Sailboat (unid)	Off Santa Barbara	G									
Catamaran (unid)	Off Santa Barbara	G									
Cabin cruiser (unid)	Off Naples Reef	G	G	G			G	G	G	G	
Sailing (PILOT)	Off Santa Barbara	G									G
Oil crewboat (unid)	NE of Hillhouse	G									
Oil crewboat (unid)	N of Hope	G									
Oil Crewboat (JUNE TIDE)	NW of Holly	G	G		G	G		F		G	
Oil crewboat (MALLARD)	E of Ellwood Pier	F*	F*	F*	G		F*	G	F*	P*	F*
Ocean tug (unid)	SW of Holly-SW of Capitan	G	G	G		G				G	
Ocean tug (CONTENDER)	E of Elwood Pier	F*	F*	F*	G		F*	G	F*	P*	F*
Sand barge (unnamed)	Off Santa Barbara	G									G
Sand barge (unnamed)	Off Santa Barbara	G									G
Cutter (PT. JUDITH)	Off Holly	G	G	G	G	G	G	G	G		G

* Merged return; vessels anchored approximately 30-40 meters apart

Date: May 19, 1976

Location: Santa Barbara Channel between Carpinteria and Capitan (see Figure 2)

Systems: APS-94D and COR

COR (Use with Table 2, Appendix B)

TARGET	LOCATION	Run (see Figure 1A)									
		0	1	2	3	4	5	6	7	8	9
<u>BUOYS, FLOATS, AND MOORINGS</u>											
Positioning buoys/floats	SW of Capitan	F								G	
Coast Guard Float	SW of Holly	G	P	G	ND						
7-point mooring	Off Casitas Pier	G									
5-point mooring	Off Coal Oil Point	F	P	P	G	G	G	G	ND	G	G
5-point mooring	Off Capitan	P	ND	ND		G					
Marker buoy	SW of Coal Oil Point	P	F	ND	G	G	G	ND	ND	P	P
Navigation buoy	Off Santa Barbara (inner)	P									
Navigation buoy	Off Santa Barbara (outer)	ND									
Live bait float	Off Goleta Pier	P		ND	ND	G		ND	ND		G
<u>PIERS AND PILINGS</u>											
Casitas Pier	SE of Carpinteria	G									
Biltmore Pier	E of Santa Barbara	P									G
Stearns Wharf	Santa Barbara	F									P
Goleta Pier	S of Goleta	P	P	P	ND	G	G	G	G		G
Elwood Pier	S of Elwood	G	G	G	G	G	G	G	G	G	
Pier support	E of Elwood Pier	P	G	P	ND	G	G	G	G	F	
<u>PLATFORMS</u>											
Union A	Off Summerland	G									
Union B	Off Summerland	G									
Hillhouse	Off Summerland	G									
Hilda	Off Summerland	G									
Hazel	Off Summerland	G									
Houchin	Off Carpinteria	G									
Hogan	Off Carpinteria	G									
Hope	Off Carpinteria	G									
Heidi	Off Carpinteria	G									
Holly	Off Coal Oil Point	G	G	G	G	G	G	G	G	G	
Spider	Off Santa Barbara	G									ND
<u>SURFACE SLICKS</u>											
Oil	Platform A-Santa Barbara	G									
Oil	Off Hope Ranch	G		G	G			G	G		ND
Oil	Off Goleta Pier	G	ND	G	G	ND	ND	G	G		F
Oil	Off Coal Oil Point	G	F	G	G	ND	F	G	G	G	F
Oil alcohol	SW of Holly		ND	ND	ND	ND	ND	ND	ND	ND	
Oil alcohol	SE of Holly							P	G	G	G

TARGET	LOCATION	Run (see Figure 1A)									
		0	1	2	3	4	5	6	7	8	9
<u>VESSELS</u>											
Sailboat (unid)	SW of Goleta Pier- SW of Holly	G	P	G	ND	G	G	G	ND	G	
Sailboat (unid)	Off Goleta Pier	P		ND	ND	ND		ND			
Sailboat (unid)	Off Santa Barbara	F									P
Catamaran (unid)	Off Santa Barbara	G									
Cabin cruiser (unid)	Off Santa Barbara	P									
Sailing (PILOT)	Off Naples Reef	P	ND	P	ND	G	ND	ND	G	G	
Oil crewboat (unid)	NE of Hillhouse	G									
Oil crewboat (unid)	N of Hope	G									
Oil crewboat (JUNE TIDE)	NW of Holly	G	G	P*	G	F*	F*	F*		ND	
Oil crewboat (MALLARD)	E of Ellwood Pier	P*	F*	P*	P*	P*	F*	F*	ND	F*	
Ocean tug (unid)	SW of Holly-SW of Capitan	G		G		G				ND	
Ocean tug (CONTENDER)	E of Elwood Pier	P*	F*	P*	P*	P*	F*	F*	ND	F*	
Sand barge (unnamed)	Off Santa Barbara	ND									ND
Sand barge (unnamed)	Off Santa Barbara	G									G
Cutter (PT. JUDITH)	Off Holly	G	G	G	ND	G	G	G	ND		G

* Merged return; vessels anchored approximately 30-40 meters apart

Date: May 20, 1976
Location: Santa Barbara Channel between Hueneme and Ventura (see Figure 4)
Systems: APS-94D

APS-94D (Use with Table 3, Appendix B)

TARGET	LOCATION	Run (see Figure 1B)							
		0	1	2	3	3A	4	5	
<u>BUOYS, FLOATS AND MOORINGS</u>									
Buoy #1	Off Ventura Pier	G			G	G	F	G	
Buoy #2	Off Ventura Marina	G			G	G	G	G	
Buoy #3	SE of Ventura Marina	G			G	G	G	G	
Buoy #4	Off Mandalay Beach			G	G	G	G	F	
Buoy #5	SE of Channel Island Harbor		G	ND		G	ND	ND	
Buoy #6	Off Hueneme Harbor		G	G			G	G	
Buoy #7	Off Ormond Beach		F	F					
5-point mooring	Off Ventura Pier	G			G	G	G		
5-point mooring	Off Ventura Marina	G			G	G	G		
9-point mooring	Off Mandalay Beach			G	G	F	F	G	
9-point mooring	Surrounding CUSS I	G			G	G	F	F	
Coast Guard float	Off Channel Island Harbor		F	G					
<u>PIERS, ROCK GROINS, AND BREAKWATERS</u>									
Ventura Pier	Ventura	G			G				
Hueneme Pier	SE of Hueneme Harbor		G						
Corps Pier	SE of Hueneme Harbor			G		G	G		
Breakwater	Off Ventura Marina	G			G		F		
Breakwater	Off Channel Island Harbor		G	G		F	F	F	
Rock groin	Hueneme Harbor		G	G		F	F	F	
<u>VESSELS</u>									
Sailboat (unid)	SE of Channel Island Harbor			G					
Sailboat (unid)	Off Channel Island Harbor						G		
Cabin cruiser (unid)	E of Channel Island Harbor		G						
Cabin cruiser (unid)	SE of Channel Island Harbor		G						
Cabin cruiser (unid)	SW of Channel Island Harbor		G						
Fishing boat (ESTRELLA)	SE of Channel Island Harbor			G					
Fishing boat (unid)	SE of Corps Pier-SE Channel Island Harbor		G	G		G	G		
Fishing boat (unid)	SW of Channel Island Harbor						G	G	
Utility craft	Inside Channel Island Breakwater			F					
Drone recovery	Off Corps Pier		G	G					
Oil crewboat (WARM TIDE)	Off Hueneme Harbor					F	G	G	
Oil workboat (CALDWELL)	Alongside CUSS I	ND			ND	ND	ND	ND	
Oil drilling (CUSS I)	W of Ventura	G			G	G	G	G	
Cutter (USCG 41')	Off Channel Island Harbor		G	G					
Cargo (PRES. TAFT)	Off Ormond Beach							G	

Date: May 21, 1976
Location: Off Morro Bay from Pt. San Luis to Pt. Estero (see Figure 6).
Systems: COR

COR (Use with Table 4, Appendix B)

TARGET	LOCATION	Run(see Figure 1C)										
		8	9	10	11	12	13	14	15	16	17	
<u>BUOYS</u>												
Buoy #1	SE of Pt. San Luis	G										
Buoy #2	SW of Pt. Buchon	G	G		G	G		G	G			
Buoy #3	S of Morro Rock	G	G	G	G	G		G	G	G		
Buoy #4	NW of Morro Rock	G	G	G	G	G		G	F	G		
Buoy #5	NW of Morro Rock	G	G	G	G	G		G	F	G		
Buoy #6	SW of Chrvron Pier	ND	F	F	ND	ND		G	F	ND		
Buoy #7	NW of Chevron	G	F	P	G	G		F	F	P		
Buoy #8	S of Cayucos Pier	P	F	P	G	G		P	G	P		
Buoy #9	NW of Cayucos Pier	G	G	F	G	G		F	F	G		
Buoy #10	NW of Morro Rock	G	G	G	G	G		G	G	F		
Buoy #11	Morro Bay Channel				G							
Buoy #12	Morro Bay Channel				G							
Buoy #13	Morro Bay Channel				G							
Buoy #14	Morro Bay Channel				G							
Buoy #15	Morro Bay Channel				G							
Buoy #16	Morro Bay Channel				G							
<u>MOORINGS</u>												
4-point	San Luis Obispo Bay	F										
5-point #1	Off Morro Bay	F	G	G	F	G		F	G	P		
5-point #2	Off Morro Bay	F	G	G	G	G		P	G	P		
5-point #3	SW of Chevron Pier	F	G	G	G	G		P	G	F		
7-point #1	NW of Morro Rock	F	G	G	F	G		P	F	F		
7-point #2	NW of Chevron Pier	ND	G	G	ND	G		P	G	F		
<u>PIERS AND ROCK GROINS</u>												
Avila Pier	Avila Beach	G										
Oil Pier	NW of Avila Beach	G										
Pt. San Luis Pier	Port San Luis	F										
Chevron Pier	NW of Morro Beach	G	G	G	F	G		P	G	G		
Cayucos Pier	Cayucos	F	G	G	G	F		P	ND	P		
Rock groin	Off Pt. San Luis	G										
Rock groin	SE of Morro Rock	G	G	F	G	G		G	G	G		
Rock groin	Adjacent to Morro Rock	G	G	ND	G	G		G	G	G		

TARGET	LOCATION	Run (see Figure 1C)									
		8	9	10	11	12	13	14	15	16	17
<u>VESSELS</u>											
Cabin cruiser (unid 35')	SE of Morro Rock			F		G		F			
Cabin cruiser (unid 30')	SW of Morro Rock							ND		G	
Cabin cruiser (unid 30')	Off Morro Rock							G	G		
Cabin cruiser (unid 25')	SE of Morro Rock			F		G		P			
Fishing boat (unid 50')	SE of Morro Rock			F		G		P			
Fishing boat (unid 40')	SE of Morro Rock			G		G		G			
Fishing boat (unid 40')	Off Morro Rock								G	G	
Fishing boat (unid 35')	Off Morro Rock							G	G	G	
Cutter (CAPE HEDGE)	Off Morro Rock		G	G	G	G		G			